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FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

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The Meaning of Paris

WHAT the Farnborough Display is to Great Britain the Paris Aeronautical Salon is to the world. The Americans tried their luck at taking over that distinction at Las Vegas earlier this year; but though the event was notable in many respects the nations of the Old World declined to play up to the expected form. So the Paris Show endures, as it has endured for fifty years, as the doyenne of international air shows; which is just, because no comparable event has ever been the means of displaying, on an international scale, a greater measure of technical advance.

Our first Paris Show Report appeared in our very first issue. We described it as "the first real exhibition of practical flying machines that has been held anywhere." In that same issue we also reported as follows: "We observed a large band of Esperantists in charge of a guide who explained the different exhibits in the International tongue. At the stand where the Wright machine was exhibited they met with a particularly hearty reception from one of the directors, who himself addressed them in Esperanto."

Esperanto has not, perhaps, achieved for international relations what its initiators once hoped it would. But the Paris Show is increasingly an occasion for global participation, and increasingly a force for international rivalry—from which, in the air world at least, some of the firmest friendships have stemmed.

European Challenge

IT was perhaps with exaggerated self-assurance that B.E.A. and B.O.A.C. declared that they had no intention of joining Air Union, the new Air France-Lufthansa-Alitalia-Sabena consortium. One of the two chairmen, indeed, was reported to have said that Air Union was a "narrow co-operation"; and that airlines should preserve their own characteristics.

This apparent contradiction typified British perplexity about the meaning of the new Continental air alliance. We rather patronizingly say that Air Union is obviously a splendid thing—though of course not for us. We talk about domestic and Commonwealth interests, and the need to preserve the identity of our airlines: yet Air Union (comprising two airlines with deep obligations to overseas national territories, and whose four members will retain their identities) has reconciled all these things.

Let there be no misunderstandings about the new European air power. By curbing wasteful air transport nationalism Air Union will achieve two objectives. First, it will cut costs in a big way, by rationalizing services and—later—equipment. Second, it will gradually come to speak with one voice around the international air traffic-rights bargaining tables.

Could it not be that the time has come for us to ask ourselves, in the light of this exemplary statesmanship, whether it makes much sense (for example) for our Corporations to squabble—as they do—about their shares of European traffic; to expend so much energy in forestalling British independent attempts to expand; and to duplicate so many of their administrative services?

FROM ALL QUARTERS

Record Entry for Farnborough

A RECORD number of 376 companies will be exhibiting at this year's S.B.A.C. Flying Display and Exhibition at Farnborough (September 7 to 13). The exhibition building will again cover about 125,000 sq ft, but the outside equipment display will be 50 per cent bigger than last year's and the guided-weapon park is to be enlarged by 40 per cent. The Society states that, while it is too early to give a full list of aircraft which will be present, they hope that the Vickers Vanguard, Armstrong Whitworth Argosy, Short SC.1 and Saro Hovercraft will be included.

The Blériot Race

FEW new details of entries for the *Daily Mail* Blériot Anniversary Race (July 13-23) are yet known, but the newspaper has stated that "already several hundred entry forms have been issued to would-be challengers in the race for the fastest competitor between Marble Arch and the Arc de Triomphe." Last Friday *Flight* learned of the entry of a Westland Widgeon, Piaggio 166 and Bell 47, jointly by Mr. K. McAlpine and Helicopter Sales Ltd.

Mr. Harold Watkinson, Minister of Transport and Civil Aviation, has said "my Ministry is perfectly willing to consider any idea or project . . . and give as much help as we can." (The Ministry has the responsibility of approving flight-plans and any unorthodox take-off or landing methods or sites.)

SC.1 Progress

ON June 2 the Short SC.1 VTOL made its longest free hovering flight to date. Taking-off in gusty weather from the platform of its test gantry at Belfast, it flew forwards for a quarter of a mile over a concrete road, hovered at from 25 to 30ft, executed several turns and flew sideways under perfect control, and finally was manœuvred backwards to land on a small metal platform on the runway. The SC.1 was airborne for six minutes.

Most of the flying of this aircraft has been conducted by the company's chief test pilot Tom Brooke-Smith. After his latest mission he said: "All is now set fair for the final phase of our test programme which will be complete transition from vertical take-off to flight as a normal aeroplane and the reverse. I have the utmost confidence in the outcome of the transition test, which we shall begin shortly."

New Engines

GAS-TURBINE engines of diminutive size were displayed recently at the World Congress of Flight and Hanover Industrial Fair. The American engine, probably the smallest gas turbine yet developed, is the Curtiss-Wright Turbo-mite, designed and developed by the division at Santa Barbara, Cal. Features include a back-to-back centrifugal compressor and inward-radial turbine turning at 92,000 r.p.m., a circumferential combustion chamber and, when used to provide electrical power, an integrally mounted alternator turning at 24,000 r.p.m. The Turbo-mite has a diameter of 10in, a length of 13½in and a weight of 30 lb, and is available in 5 to 10 h.p. models.

The German engine is the B.M.W. 6002 and is rated at 50 h.p. At full power the turbine speed of 45,000 r.p.m. can be reduced by gearing to output speeds between 11,000 and 3,000 r.p.m. and maximum consumption of kerosine or petrol is 66 lb/hr.

A larger gas turbine has been unveiled by Solar Aircraft, of San Diego, Cal. Named Saturn, it has a sea-level rating of 1,250 h.p., weighs 950 lb, and has a simple-cycle s.f.c. of 0.60 (thermal efficiency 23 per cent). Fixed-r.p.m. and variable-speed versions are to be marketed for a variety of applications.

New piston engines are still appearing, and Potez in France have recently announced a new range of horizontally opposed units. The first of this family are rated at 90 h.p. (four cylinders, 3.42 lit.) and 180 h.p. Operating on 80-octane fuel, the former can deliver up to 96 h.p. at 2,530 r.p.m.

Marconi Early Warning Contract

IN October 1957 Marconi's Wireless Telegraphy Company and the Compagnie Générale de Télégraphie Sans Fil, announced their intention to collaborate in certain aspects of NATO work. Earlier this month they jointly stated that "their proposals for the provision and installation of equipment for all stations in the Early Warning Chain have been accepted and that contracts are now being placed by the Governments concerned."

Total value of the contracts is approximately £7m. This sum covers the supply and installation of equipment, the training of national personnel and assistance in maintaining the stations after hand-over. The international nature of the work is underlined by the news that the two companies will award "substantial sub-contracts" to Italian industry.

APPOINTED chief designer, light aircraft, of Short Bros. and Harland Ltd., is Mr. F. H. Robertson (left), formerly chief project designer; he will be responsible for design and development of the SC.7 light freighter. Mr. J. C. Buck (right) succeeds him as head of the project office, with the title "chief of preliminary design"

Inertial Guidance for Drone

ONE of the largest development and production contracts yet received by the inertial-guidance plant at St. Petersburg, Fla, of the Minneapolis-Honeywell Regulator Company, covers the manufacture of a new miniaturized inertial system for the navigation of the Fairchild USD-5 Drone of the U.S. Army.

According to the general manager of the St. Petersburg plant "the drone's guidance system will enable the Army to pin-point battle-area targets for such missiles as the Redstone, Sergeant, or Pershing, several hundred miles behind enemy lines."

The system, which will incorporate a variation of the well-known MIG gyro units, will be able to guide the drone over several preselected target areas in a single mission without the need for any radio or radar guidance.

Agusta Choose the Gnome

IN our "Helicopters of the World" special issue of May 15 we announced a project by Costruzioni Aeronautiche Giovanni Agusta of Milan for a 25-seat transport Helicopter. For many months Agusta have been evaluating a variety of powerplants, and the de Havilland Engine Company are now able to announce that the new helicopter will, in fact, have three Gnome shaft turbines. This is the first foreign sale of the Gnome to be announced; the basic engine is, of course, essentially a development of the T58, and is manufactured under licence from American General Electric. The first all-D.H. Gnome ran successfully on June 5.

Designated Agusta 101G, the new helicopter is illustrated here for the first time. Few details of the aircraft have been released, but it is stated that it is under development against a contract placed by the Italian Government, and is expected to fly before the end of this year. As the artist's impression shows, the Gnomes are mounted above the roof of the passenger cabin; Nos. 1 and 3 engines are disposed radially from the rotor hub.

SHORT CIRCUIT: As noted in a news-item on this page, the Short SC.1 recently made a six-minute flight at Belfast. The aircraft is here shown moving forwards above a road on the airfield at Sydenham

GNOME ROTARY: First aircraft to be designed around the de Havilland Gnome engine is the Agusta 101G (right), which will have three Gnome H.1000 turboshaft units. Main and tail rotors will each have four blades, the diameter of the former being 64ft 11in. Further details above

IN BRIEF

Lockheed Aircraft Corporation have announced a new version of the Starfighter, designated F-104-9. Intended for purchase by NATO, SEATO and other nations, the -9 will be externally indistinguishable from the F-104C, but will be "re-engineered and rationalized."

* * *

At the end of last month Fokker announced in Amsterdam that their Brazilian affiliate has closed its plant in Rio de Janeiro owing to the refusal of the Brazilian Government to pay £1,923,000 under a contract for training aircraft.

* * *

At the 16th annual general meeting of the Society of Licensed Aircraft Engineers, held in London on May 30, the Silver Turnbuckle Award was presented to A. Cdre. Sir Vernon Brown, for his outstanding services to aircraft engineering and in particular his work towards safety in aviation.

* * *

It is reported that Sir Roy Dobson, at present in Canada for discussions with the R.C.A.F. and Department of Defence Production, has suggested that the R.C.A.F. should replace its Canadair Sabres with the Hawker 1127 VTOL fighter. The latter, powered by a special Bristol Siddeley fan engine, would be manufactured in the Avro plant at Malton. Sir Roy is quoted as saying, "Whatever replaces the Sabre jet fighters will be built in Canada."

LUTON, May 29: Sir Hugh Constantine, AOC-in-C Flying Training Cmd.; Mr. W. A. Summers, Hunting mg. dir.; Mr. George Ward, Air Minister; test pilot S. B. Oliver. Mr. Ward flew in two Jet Provosts

Owing to printing difficulties over which we have no control, this issue of *Flight* is reduced in size and may be delayed in publication. Next week's issue may be similarly affected. Readers will, we know, bear with us.

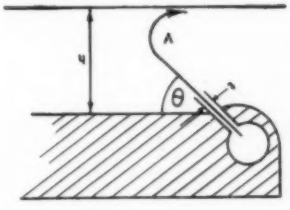
THE HOVERCRAFT BECOMES REALITY

YESTERDAY, June 11, the Saunders-Roe S.R.N.1 was to be publicly demonstrated for the first time. During the past week tethered and free-flight trials have been taking place, and by today—after round-the-clock working—the blue-and-white S.R.N.1 should have provided the first practical demonstration of an entrained-air-cushion vehicle in this country.

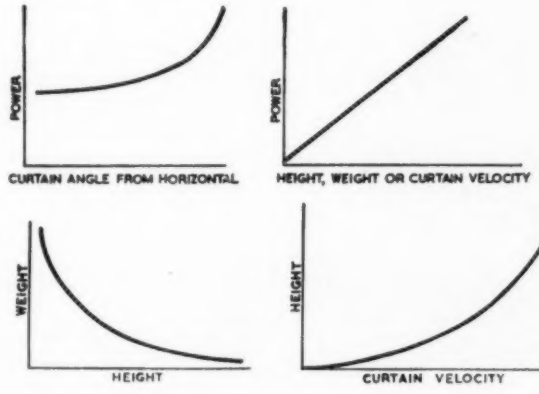
The hovercraft started in 1953 as the private venture of Mr. C. S. Cockerell, formerly an electronics engineer who later devoted much of his time to studying the effects of air-blowing on boat hulls in his boat business at Lowestoft. The aircraft research branch of the M.o.S. started to take an interest in the project in 1956 and the following year Saunders-Roe were given an M.o.S. contract to make an appraisal of the concept. In 1958 the National Research Development Corporation—a government body set up to exploit inventions outside normal business risks—decided as a result of the "immense potential" revealed by the Saunders-Roe investigation to provide further financial support and a subsidiary, Hovercraft Development Ltd., was formed to control the projects. (An earlier note on the N.R.D.C.'s interest and a drawing of S.R.N.1 appeared in *Flight*, April 24.)

The Alvis Leonides-powered S.R.N.1 is 30ft long, 24ft wide and has a gross weight of about 7,500 lb, although hovering performance is still possible with 20 people on the decking (as opposed to the normal operating crew of two). The operating height is 15in and cruising speed about 25 kt.

The operating principle is the generation of a cushion of air of sufficient pressure (perhaps 15-20 lb/sq ft) to support the craft over its bottom surface; the cushion is contained within a curtain of air that flows on to the ground or water from a peripheral annulus on the under-surface and it is the force required to bend the curtain outwards that dictates the magnitude of cushion pressure that can be built up and sustained.



On the left is shown the ejection of the air curtain from a peripheral annulus that is the basis of the hovercraft principle. Below are illustrated the effects of various design parameters; the manner in which they are equated is explained in the text



The following—the first technical explanation of hovercraft principles ever to be published and prepared for *Flight* by Mr. C. S. Cockerell—is a simplified treatment of the theory.

Neglecting second order effects, consider (in a vertical plane) flow of unit width of a thin air curtain. Equating the rate of momentum change in the air curtain and the forces acting on the air curtain by the air cushion:

$$\rho V^2 t\,(+\cos\theta) = p_c h \quad \text{..... Equation (1)}$$

(Where: V = air curtain velocity; t = thickness of air curtain; θ = initial angle of incidence relative to horizontal; h = craft height; p_c = cushion pressure; ρ = air density.) Also the total thrust of the air cushion on a craft of circular form is:

$$2\pi r \rho V^2 t \quad \text{..... Equation (2)}$$

and the weight of the craft W is given by $W = \pi r^2 p_c$ ... Equation (3)

Substituting equations (2) and (3) into equation (1)

$$\frac{T\,(1+\cos\theta)}{2\pi r} = \frac{Wh}{\pi r^2}$$

$$\text{Hence } \frac{W}{T} = \frac{r}{h}(1+\cos\theta) \quad \text{..... Equation (4)}$$

The maximum value of $(1+\cos\theta)$ occurs for horizontal inward-facing jets and it is interesting that in this case there is no direct thrust contribution to the lift of the craft. Equation (4) shows that the value of weight over thrust (corresponding to the lift/drag ratio of an aerofoil) is proportional to the radius of the craft divided by the height; so for high efficiency the hovercraft must be large in terms of its operating height.

Putting power requirement for lift $P = T \times V$ in equation (4)

$$\frac{P}{W} = \frac{V \times h}{r\,(1+\cos\theta)} \quad \text{..... Equation (5)}$$

Hence for minimum power V must be as small as possible; the lower practical limit depends on the cushion pressure whose limit depends upon the velocity for which the craft is designed.

The first curtain configuration to be tested by Saunders-Roe consists of an inner annular curtain for pitch and roll stabilization and an outer curtain to contain the air cushion. The two curtains are spaced about 48in apart. Other configurations are clearly possible; a Y-shaped annulus might be adopted for pitch and roll stabilization or—as adopted by the U.S. Navy's Bureau of Aeronautics Skimmer hovercraft—a longitudinal slot and two transverse slots across the under-surface.

As with any aircraft, the first free flight represents only the "end of the beginning" stage in development. The practical (as opposed to theoretical) unknowns are still the effects of obstructions, of high waves and of disturbances on stability.

The most promising application for research with the S.R.N.1 appears to be in the development of large marine craft. The N.R.D.C. foresee a cross-Channel ferry weighing about 100 tons and a 400-ton vehicle ferry as likely propositions.

The idea of a cross-Channel car and passenger ferry which completes the shortest sea crossing in 15 or 20 minutes is most attractive, but is it a year-round proposition and could it be made to pay its way? Much air must pass underneath the hulls of hovercraft before these questions can be satisfactorily answered. Present research indicates that a large hovercraft could ride waves 13ft deep from trough to crest, and that this would be satisfactory for North Sea operation on 95 per cent of all occasions. Stability, cross-wind handling and berthing problems in craft of this size have as yet hardly been explored.

Operational costs have been theoretically investigated and are said to be less than those of present ferries. This contention is not easy to accept, because size-for-size first cost would be very much higher, fuel consumption probably greater and maintenance and insurance a higher proportion of annual charges.

Discoverer 3 was launched from Vandenberg A.F.B. on June 3 but did not attain orbit. Four mice were carried in the environmental capsule, seen (above right) being installed in the re-entry body. Above left, the re-entry body is attached to the Thor-Hustler launching vehicle

Missiles and Spaceflight

DISCOVERER 3 LAUNCH

An unsuccessful attempt to place in orbit the second stage of a Thor-Hustler rocket, from which a capsule containing four mice was to have been ejected and recovered, was made from Vandenberg A.F.B. on June 3. Designated Discoverer 3, this was the third polar-orbit satellite launch in the programme sponsored by the Advanced Research Projects Agency, and would have marked the first attempt to recover animals from orbital flight. On June 4 it was announced that the satellite had "almost certainly" re-entered the Earth's atmosphere and had been burned up. The director of ARPA, Mr. Roy Johnson, said that it appeared that re-entry took place several thousand miles south of Vandenberg, shortly after the launch. One possibility under investigation was that the angle of injection into orbit had been incorrect.

The intended orbit was at an altitude of 140 to 485 miles and, as with Discoverer 2, the plan to eject the capsule and to recover it involved C-119 aircraft and ships patrolling a target recovery area near the Hawaiian Islands. This recovery attempt was to have been made after 17 orbits, estimated to take about 26 hours.

The launching vehicle was identical with those used in the first two Discoverer firings, and comprised a first-stage Thor and a Lockheed second stage powered by a Bell Hustler engine. The four mice, stated to be physically stronger and emotionally more stable than average, were provided with a food supply comprising a mixture of ground peanuts, orange juice, oatmeal water and gelatine. The experiment was designed to determine the effect of orbital flight on the heart action, respiration and muscular activity of the mice. A secondary objective was to study the composition of outer space radiation, and the total radiation dosage encountered by a satellite.

THE TOO-ACCURATE SEASLUG

Earlier this month Sir W. G. Armstrong Whitworth Aircraft Ltd. showed a colour film of the Seaslug missile in action from *H.M.S. Girdle Ness*. A surprising piece of news arising from the film is that recent trials with live warheads have resulted in such consistent destruction of the target—and loss of the cameras which each target carries—that trial rounds are now being programmed to miss their targets by a predetermined distance. During a recent programme of trials at the Woomera range three rounds with live warheads were fired against jet drones. The first two destroyed their targets and, in order to preserve the instrumentation in the third, the final round was given a miss-distance to which it adhered accurately.

OPERATIONAL ATLAS ERECTOR

A photograph on this page depicts the first operational erector/launcher constructed by Convair Astronautics for the U.S.A.F. Previously all Atlas missiles at Cape Canaveral and Vandenberg have been erected by rigs in which elevation has been accomplished by cables passing through pulleys at the top of the test tower (which is eliminated in the operational weapon system). At present plans are afoot to make all Atlas complexes "hard," and even in surface installations the missile and launcher/erector mechanism will be enclosed in a blast-proof concrete building.

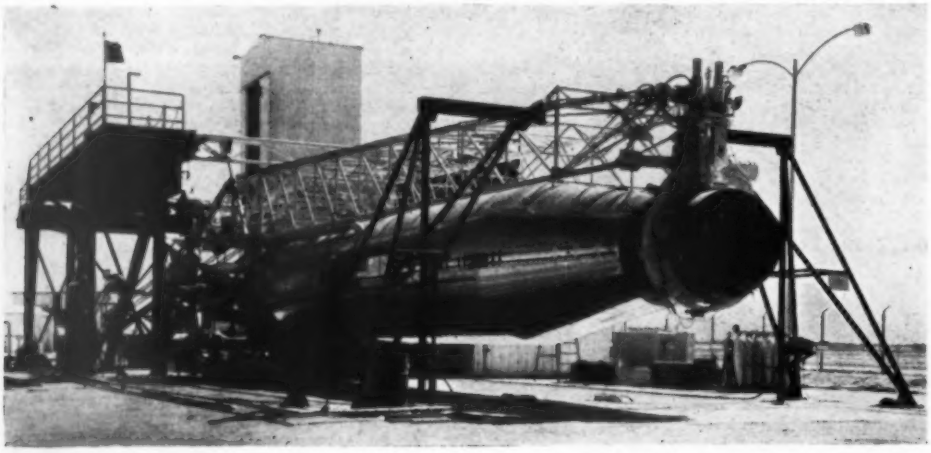
Like Thor but unlike Titan, Atlas missiles will be stored in the horizontal position. The elevating arm takes the form of a hinged cantilever fabricated from steel tubing. This is hinged to the pad trunnion structure, and at its upper end carries caliper jaws which engage with the corrugated re-entry body.

Elevation is effected by a 75 h.p. motor, which will pull the missile and pad trunnions upright as a single rigid assembly. Once erected, the nose-cone clamp is opened hydraulically to permit the boom to swing clear.

Able, the larger of the two monkeys which made the 1,500-mile flight in the nose-cone of a Jupiter IRBM from Cape Canaveral on May 28, died under an anaesthetic at the U.S. Army medical research laboratory at Fort Knox, Kentucky, on June 2, during an operation to remove an electrode beneath her skin.

On June 1 the Australian Defence and Air Ministers, Athol Townley and Frederick Osborne, flew 1,250 miles over the extended Woomera range, as far as Broome, Western Australia. The following day they went on to Talgarno, close to the anticipated impact point of the Blue Streak LRBM, flight testing of which will begin next year.

Production of Lacrosse missiles for the U.S. and Canadian armies is back on schedule after a delay caused by technical difficulties. At the end of May the U.S. Army awarded an additional production contract totalling $15,181,000 to Martin's Orlando Division to continue deliveries.



Installed at the Convair Astronautics plant north of San Diego, this operational erector/launcher for Atlas (see news item above) is the first such system to have been constructed for an ICBM. The background tower does not form part of the system, and the nose-cone on the round shown is a dummy

THE FRENCH INDUSTRY

Current Products and Prospects

THE French aircraft industry is in many ways very similar to that in Britain and it has, during the past two years, suffered a reduction of defence orders in very much the same way. But apparently regrettable cut-backs are offset by the fact that France has a Mach 2 intercepter and, unlike Britain, a supersonic bomber. Sud alone have built over 1,000 helicopters, many of them turbine-powered, and a jet airliner has gone into service.

A few vital statistics serve to size up the industry in general. Altogether, it employs 85,000 people, and last year the turnover was nearly Fr. 200×10^9—approximately equivalent to that of the French ship-building industry. Covered floor area totals 21,520,000 sq ft, half of it used by the airframe constructors. Of 23,700 machine tools, 39 per cent are used for airframes, 26.5 per cent for engines, and 34.5 per cent for equipment manufacture. The accompanying map illustrates the distribution of the aircraft factories and the concentration of 60 per cent of the manpower in the Paris region. While 1957 was a peak year for employment, 1958 saw a 20 per cent reduction of labour for equipment manufacture and a 12 per cent reduction for engines. Of the manpower force, 7 per cent are engineers and executives, 33 per cent technicians, designers and administrative, and 60 per cent specialist, skilled and unskilled workers. About one-third are occupied on prototype and research work.

Among the 250 aeronautical companies, 18 airframe and engine manufacturers employ 73 per cent of the total manpower. Of the 250, 157 companies belong to the Union Syndicale des Industries Aéronautiques (equivalent to the S.B.A.C.). It is noticeable that sub-contract work is well spread around to keep each company busy as far as possible. A tremendous effort has gone into the rapid production of the Caravelle, in which probably 50 per cent of the French industry is involved. A number of aircraft companies, such as Latécoère, Sipa and Hurel-Dubois, subsist virtually on sub-contracts. Hispano Suiza is now concentrating on hydraulics. French manufacturers have established an excellent reputation for landing gear, powered controls, radio and instruments, and for large radar aerials.

Carefully stimulated by the Government, the club and touring aircraft movement has given birth to a number of thriving small companies with quite large production capacity. Amongst these are Wassmer, S.A. Normande, Fauvel, Coopavia, Rousseau Dinard, Alpavia and several others.

The following are brief notes on the major companies.

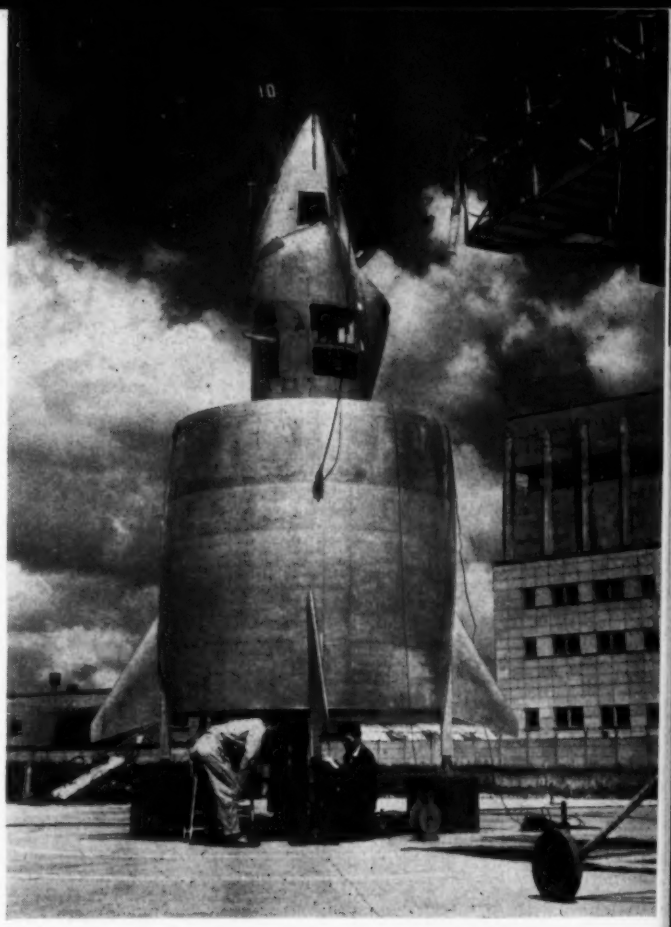
CURRENT PRODUCTION

Bréguet Over the years Bréguet have been responsible for some remarkable designs, but have also suffered ill-fortune. The very promising 1001 Taon and 1100 were cancelled. The 761 Deux Ponts gave excellent service but did not catch on, and the order for fifteen 765 Saharas was cut to four, leaving the company with the sub-assemblies for the remainder "on the shelf." But full production has begun at Biarritz for a batch of 75 Alizés, which are claimed to be the best single-engined anti-submarine aircraft in the world. Against fierce opposition, Bréguet have won the competition for the NATO maritime patrol aircraft with the Rolls-Royce Tyne-powered 1150, and construction of the first of these has begun.

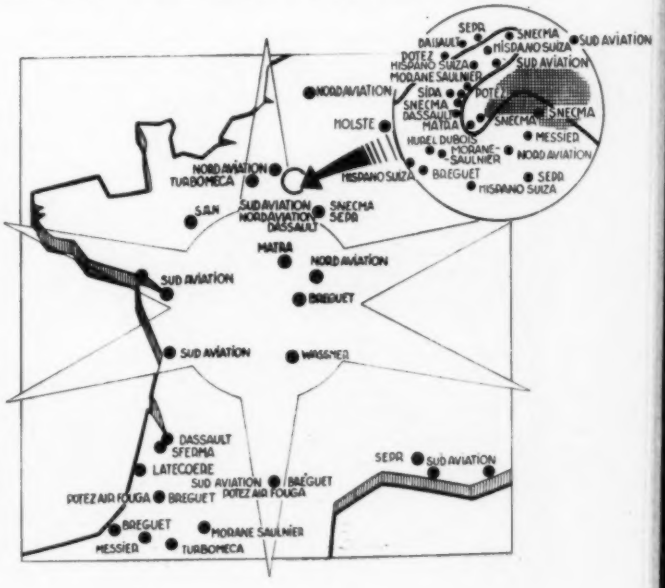
After considerable successes with the 901 glider, a batch of 100 Fauvette standard-class single-seaters has been begun, and the Choucas two-seater will fly soon. The S10 stratospheric research glider is also nearly complete. It is reported that Bréguet are to demonstrate a Taon at Paris; and details have been released of the 1005, an advanced Taon powered by a Bristol-Siddeley Orpheus 12.

One of the most remarkable Bréguet projects yet is the Intégral, of which the 940 prototype has now been flying for some time. At 14,300 lb, in zero wind, it can reach 50ft in 210 yd, and should land over 50ft in the same distance. A prototype of the 941 should fly at the end of next year. (*Capital, Fr. 1,375m.*)

Marcel Dassault In most ways this is the most potent of the French aircraft companies, run with ruthless efficiency and unstinted investment in resources and advanced equipment. Mass production of Ouragans, Mystère 2s, 4s and Super Mystères, not



The dramatic spectacle of the SNECMA Atar Volant during the 1957 Paris Salon may well be followed this year by translation of the C.450 Coléoptère, seen here at Melun-Villaroche



The distribution of aircraft companies around France, with the heavy concentration in the Paris area, is illustrated at right. The division of manpower is shown overleaf

THE FRENCH INDUSTRY . . .

to mention the Flamant variants, has established the Dassault reputation for rapid and efficient production of relatively complex modern aircraft. But it seems that the Super Mystère programme was cut off in its prime in the general retrenchment of defence orders, and is not regarded as having been a commercial success. As Super Mystère production draws to a close, Dassault have an order for 100 Mirage IIIs for the French Air Force, but efforts to export the type have not yet been successful. Four pre-production Mirages are now flying. As a development of the Etendard series, the Etendard IVM is now in the pre-production stage as a carrier-borne strike aircraft. The powerful-looking Mirage IV supersonic bomber was left behind by the ever changing official specification, but it is Europe's only supersonic bomber and large research aircraft. In view of France's nuclear weapon policy, an enlarged operational version, powered by P. & W. J75s built by SNECMA, looks like a certain runner.

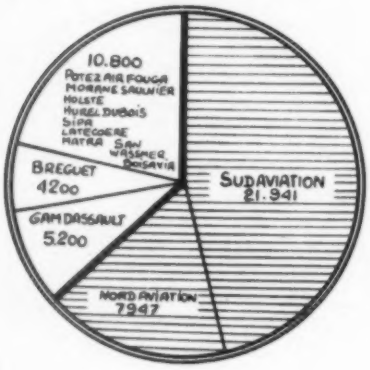
In addition to airframes, Dassault have produced turbojet engines, propellers, and fire-control radars, although their Aida and Super Aida seem to have been dropped in favour of the C.S.F. Cyrano. A Dassault entry is usually a pretty powerful competitor in any competition and the 415 Communauté which has now flown at Bordeaux promises well in this respect. Its brother, Spirale, is a totally war-like aircraft, while the Communauté could rapidly become something of a Gulfstream for business use.

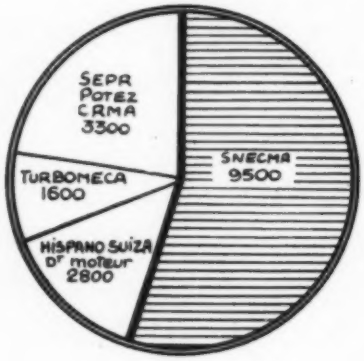
Holste The future is definitely bright for this small but energetic company. The factory at Rheims has now turned out several hundred MH.1521 Broussards, and there is still a big backlog of orders. Bright new hope is the Super Broussard, which was described in *Flight* for March 27. The prototype, powered by two 600 h.p. P. & W. engines, made its first flight on May 20, with Max Holste himself on board. In five days it made seven flights, totalling 10 hr; each engine was feathered and stalls were explored. The Super Broussard will be at Paris, and some firm orders would cause no surprise. (*Capital, Fr.61,330,000.*)

Morane Saulnier Executive sales of the outstanding four-seater, twin-jet MS.760 Paris are slowly mounting. The Shah of Persia has one, three have been sold in America, and about 40 are being supplied to the Argentine, as well as 50 to the French Air Force. *Flight* recently sampled the Paris now being used to teach flight-testing at Cranfield. The aircraft was delightful to handle, is greatly liked at Cranfield, and is proving to be a very economical and useful machine. Flight-testing of the Bastan-powered MS.1500 Epervier is continuing, though nothing has yet been announced about production orders. The clubs are to be tempted with the all-metal light Rallye two-seater. (*Capital, Fr. 316,800,000.*)

Nord Aviation Annual turnover for 1958 was 22×10^9 francs, of which 26 per cent represented exports; half of these were in SS-10 and SS-11 wire-guided missiles. Nord is thus one of France's most important exporters. Production of the 2501 Noratlas is tailing off in France, but continuing in Germany; the 2504 anti-submarine trainer is being built, the 2506 assault transport has flown, and the 2508 high-powered transport has flown at 35,000ft and re-lit its Marboré boosters at 24,000ft.

Reading from top to bottom, the first production Bréguet Alizé to leave the Biarritz factory; Bréguet's blown-wing 940 prototype taking off at Toulouse; Dassault Mirage III Mach 2 intercepter/ground-attack aircraft; and Dassault Mirage IV supersonic bomber at Melun





At far left, the distribution of personnel amongst the airframe manufacturers, the shaded segment being nationalized. The right-hand diagram shows the manpower of the nationalized and private engine manufacturers in the same way

Nord is heavily involved in air-to-air, air-to-ground and ground-to-ground missile and target development, and is also investigating supersonic flight with the Griffon 2 turbo-ramjet, which machine recently raised the 100-km closed-circuit record to over 1,000 m.p.h. The Griffon 3, if ordered, would be a Mach 3 aeroplane. The new SS-12 is a larger, more potent and ramp-launched version of the SS-11, and the CT-41, succeeding the CT-20, is a ramjet-propelled target missile. (*Capital, Fr. 4,440m.*)

Henry Potez Many constructors have been waiting for an engine manufacturer to undertake the thankless task of producing a range of good light aircraft engines—and Potez have done it with the new 4E 96 h.p. flat four. An enlarged 180 h.p. version is apparently also planned, and both units will fit the same engine mountings as their Lycoming and Continental equivalents. A batch of 4Es is now undergoing bench-testing. Potez also make the 4D.32 and 4D.34 in-line engines, respectively of 240 and 260 h.p. These engines power the two Nord aircraft for the French Army. (*Capital, Fr. 450m.*)

Potez Air Fouga Production of some 300 Magisters for the French and German Air Forces is virtually complete, although licensed production in Germany and Israel continues. When *Flight* visited the Potez Air Fouga factory at Toulouse, the first of the CM 175 Zephyrs (the name has been changed from Esquif) was coming down the line. Fouga are making the whole Zephyr themselves, whereas Magister fuselages had been sub-contracted to Sud. The company is now thinking of new types, and there seems to be a possibility of a single-seat ground attack Magister development. (*Capital, Fr. 75,000,000.*)

SEPR The development of both liquid- and solid-propellant rocket motors for a great variety of applications is in the hands of SEPR, a privately-owned company. The first aircraft propellant rocket to go into production is the pack-mounted jettisonable type 841 destined for the Dassault Mirage III intercepter. (*Capital, Fr. 315,050,400.*)

SNECMA At each Paris Show the French industry pulls something out of the bag. Last time it was the fantastic spectacle of the flying Atar wingless VTO rig. Now, the C.450 Coléoptère with its annular wing and tilting ejection seat in an enclosed cockpit has completed its tethered trials and is well into free flight in the vertical attitude. When *Flight* saw the Coléoptère at Melun Villaroche, final preparations for attempts at translation were in hand. SNECMA said they would show the Coléoptère at Paris only if it could translate in public; the rest, they said with regrettable modesty, was *vieil chapeau*. A good deal of Coléoptère design and development has been done by a team of German technicians, and the German Government is positively interested in it.

Main SNECMA function is, of course, as the nationalized engine manufacturer, producing Bristol Hercules under licence and the Atar 8 and 9 turbojets. The Super Atar, which has already given 26,500 lb thrust on the bench, is apparently to be abandoned in favour of a licence for the P. & W. J75.

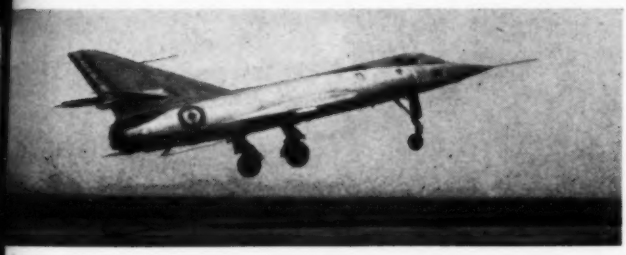
Sud-Aviation In terms of both manpower and factory resources this is the biggest aircraft company in France. Three versions of its Vautour are now in service and two versions of the Sikorsky S-58 are being built at Marignane, where F-84Fs and Aquilons are also serviced. The SE.116 Voltigeur and its civil version, the Diplomate, are progressing slowly, also at Marginane.

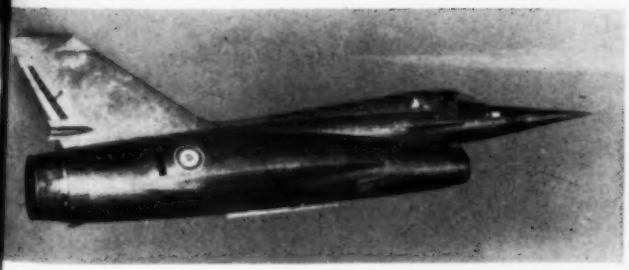
These are sound projects, but Sud's really world-wide successes are the splendid Caravelle and the family of pioneering turbine-helicopters. More than 120 Djinns have been built, and the Alouette II has really established itself with 469 ordered, 229 of them for export to 17 countries. The latter's big brother, the Alouette III, which is to be powered by a derated Bastan, promises to become an extremely potent quart-sized packet. Big things may well be in store for the SA.3200 Frelon, the 25-seater powered by three Turmos. The last two helicopters were described in *Flight* for May 15, and the tremendous effort going into the production and selling of the Caravelle were recorded in *Flight* for April 24. For a State-owned giant, Sud is doing pretty well. (*Capital, Fr. 7,890m.*)

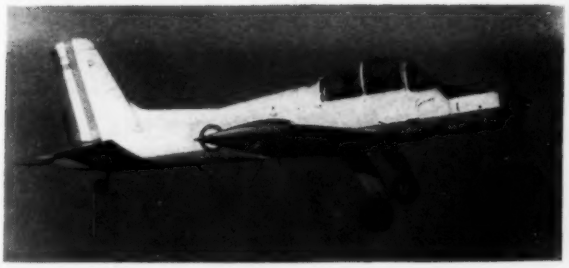
Turboméca Under the inspired leadership of M. Szydlowski, Turboméca have established a world lead in small turbine engines. The Palouste air generator, Artouste shaft turbine and Marboré turbojet are already in service in many production aircraft and helicopters. The Turmo III is destined for the big SA.3200 Frelon. Licences for all these engines are held by Blackburn Aircraft in Britain and by Continental in the U.S.A.

With this established production background, M. Szydlowski is introducing the Bastan constant-speed turboprop of 805 e.h.p. and the miniscule Astazou. It is typical of M. Szydlowski that he regards the Astazou as a failure—he designed it for 250 h.p. and it is already giving over 400 h.p. At least half a dozen new French aircraft are to be powered by Bastans, and the Compagnie Générale des Turbo-Machines, formed jointly by Turboméca and Hispano Suiza, has developed a complete, cowled Bastan power-pack ready to be bolted on to the mountings of all these aircraft. As well as having a brilliant future in new airframes, the Bastan may well be able to replace piston engines for earlier aircraft. The Beech PD.18 converted by SFERMA at Bordeaux is a typical example, and Beechcraft are themselves very interested in it. Yet more intriguing is the little Astazou, which has now flown in the Max Holste 153 prototype, also converted by SFERMA. It is reckoned that there might be a sale for about 200 Astazous installed in the remaining Nord 1100 four-seat touring aircraft. Turboméca, CGTM and SFERMA have together done excellent work in preparing the Bastan and the Astazou for service. It was at Bordes, too, that Turboméca and Bréguet worked together for a year running the engine and wing combination of the Bréguet 940 STOL prototype. (*Capital, Fr. 602m.*)

(*Contd. overleaf*)







Top, a Dassault Etendard IVM being catapulted; above, the Nord Griffon II; above, right, the Morane Epervier; and right, one of the Nord 2501 Noratlas ordered by the German Luftwaffe

Pioneer of the rear-mounted engine, and now in service with Air France and S.A.S., the Sud Caravelle (above) is one of the great achievements of the French aircraft industry

THE FRENCH INDUSTRY...

The Sud Voltigeur, later to have Turboméca Bastans, answers the offical specification for a multi-purpose ground-attack trainer and liaison aircraft. Its competitor is the Dassoult Communauté

Missiles

During the past ten years the French missile industry has crystallized as a strong and close-knit organization with excellent backing from the airframe, propulsion and electronics companies. In general their products are of relatively elementary performance, and for this reason several have already reached the operational stage; in fact, one manufacturer—Nord—has delivered many thousands of small wire-guided missiles and has achieved more export sales than any other missiles manufacturer in the world.

Latécoère Long associated with the French Navy, this company are responsible for the Malaface ship-launched bombardment missile (undergoing service-test trials), the Malafon ASW weapon now in production, and the Masalca anti-aircraft missile. The last-named is supersonic and after initial boost by a tandem rocket the internal ramjet takes over. It has cruciform delta wings.

MATRA Chief missile from this armament company is the R.511 air-to-air weapon. In production for the Vautour and Mirage, the R.511 flies at supersonic speed under the thrust of a solid-propellant motor and has a radar/optical guidance system.

Nord The SS.10 is a small, slow-flying (180 m.p.h.) wire-guided missile carrying a shaped charge, and capable of being fired from launchers mounted on the ground, on vehicles or aircraft. Large numbers have been exported—particularly to the U.S. 7th Army—and the weapon was used in action by the Israeli Army during the Sinai campaign.

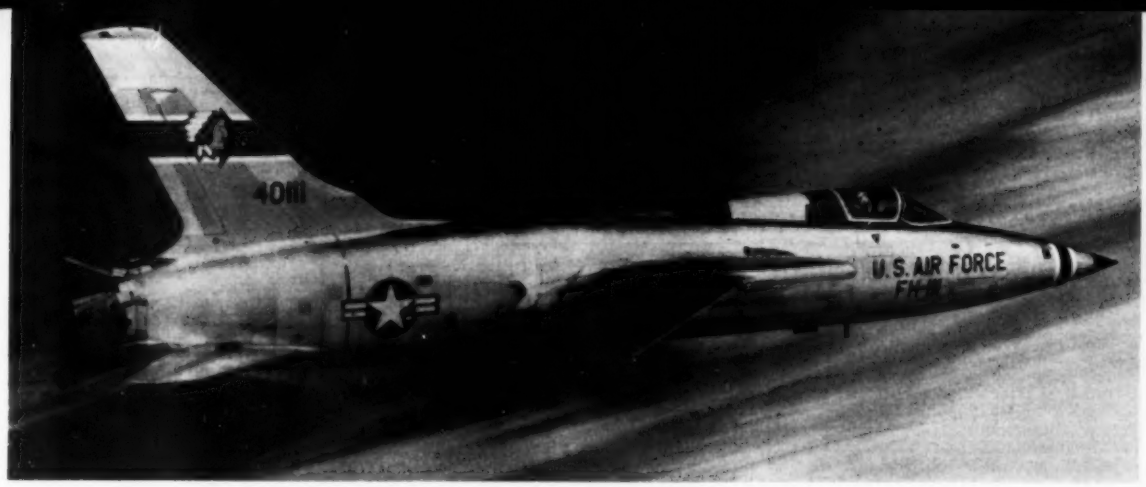
The SS.11 is rather larger and faster; the SS.11M is intended for anti-submarine operations. The SS.12 remains classified, but a photograph shows it to have a swept wing, suggesting supersonic speed, and a more advanced form of guidance than wires.

Another offshoot of this family is the 5103 air-to-air missile, in which the jet-deflection control system of the SS.11 has been allied with a supersonic airframe and visual radio-command guidance from the pilot of the launching aircraft. Large numbers have been fired from Aquilons during evaluation tests, pending delivery as the prime armament of the Mystère IV A. Nord are also responsible for the ACAM anti-aircraft weapon; apart from the fact that it has a solid motor and radio command guidance, no details are available.

Below, the Languedoc which formerly carried a Leduc ramjet is now used by CGTM in developing the Turboméca Bastan as a power package for any fixed-wing installation

"Flight" photograph

France's largest helicopter is the Sud SA.3200 Frelon, powered by three Turboméca Turmo IIIs



Thunderchief

"THE MOST POWERFUL ONE-MAN AIRPLANE IN THE WORLD"

PHOTOGRAPHS of the Republic F-105 Thunderchief do not do the aircraft justice, for a mere picture can convey little of the capability of this aeroplane. In general, it looks like an ordinary fighter, yet it can carry a heavier bomb load than a B-17 and can fly a great variety of military missions.

Initially, the 105 was a private venture by Republic Aviation Corporation of Farmingdale, Long Island. For many years this company has been one of the foremost manufacturers of fighters and fighter/bombers for the U.S. Air Force and for the Army Air Force and Air Corps before it; few of our readers need any introduction to the names Thunderbolt, Thunderjet, Thunderstreak and Thunderflash.

During 1951 the fighting in Korea provided proof of the stamina of the first generation of jet combat aircraft. Every force engaged in this battle learnt much from it—albeit "the hard way"—and the U.S. Air Force in particular determined that the forthcoming "Century series" of supersonic intercepters, fighters and fighter/bombers should mark a tremendous advance over their predecessors. Republic's own F-84G Thunderjet bore the brunt of the fighter/bomber load in Korea and proved itself both capable and popular. Nevertheless, its designer, Alexander Kartveli, now Republic's vice-president for research and development, knew that it would shortly be possible to design a far more impressive aeroplane. He and his colleagues were keenly aware of the fact that there were many missions—in particular those involving delivery of a thermonuclear weapon—which could be accomplished only by the B-47. The logical course of action seemed to be to take a B-47 bomb bay (figuratively speaking), and perhaps a miniaturized version of its bombing system, and build a smaller, supersonic aeroplane round it.

By September 1951 a small team of fifteen engineers sat down to work on the new project, which bore the company number AP-63. It was decided from the outset that the new aeroplane could be a single-seater and that it should have a single powerplant; and the engine chosen was the 15,000 lb-thrust turbojet then being planned for the Air Force by Pratt & Whitney Aircraft as the XJ75. By late 1952 enough arithmetic had been done to show that the AP-63 would work very well indeed, and the company were accordingly awarded a U.S. Air Force development contract. The project thus became the XF-105, and the engineering team working on it grew steadily to 300.

The first XF-105A (U.S.A.F. serial number 54-0098) was flown by the company's chief experimental test pilot, H. G. "Hank" Beaird, at Edwards Air Force Base on October 22, 1955, approximately one month ahead of schedule. The flight lasted 45 minutes, and before Beaird landed he had taken the new aircraft beyond Mach 1. The XJ75 was then far from ready to drive a fighter, and, in fact, had only recently started its flight tests slung from the bomb bay of a B-45. Accordingly the 105A was powered by a Pratt & Whitney J57, of much lower rating, although it was otherwise approximately representative of what Republic considered to be the production configuration.

However, more than a year previously a flood of new aerodynamic data on supersonic-aircraft design had begun to flow from the N.A.C.A., universities and aircraft companies. Application of the new information showed Republic that, provided they made the F-105 a slightly different shape, drag would be less than thrust up to speeds very much greater than its designers had ever considered. The company therefore had to conduct what might be called "an agonizing re-appraisal," which consumed many weeks but produced a better aeroplane. By 1956 this work had led to the F-105B which, although superficially similar to the A model, was in detail largely redesigned. The B was the first aircraft to be powered by the big J75—making it easily the most powerful single-engined aeroplane in the Western world at that time—and the engine was fed through a completely new duct system which had recorded remarkable efficiencies at high supersonic Mach numbers during extensive ground testing. In contrast to the A, the B was fully area-ruled and it also had a revised vertical tail surface.

The first B model (U.S.A.F. serial number 54-0101) was flown by the same pilot on May 26, 1956. Since that date Republic have never looked back. The 105 has amazed every pilot who has handled it, and it has shown itself to be the most versatile aeroplane of the entire Century series. It is appropriate at this point to examine the design and manufacture of the first production model, the F-105B, and to conclude this account with a brief reference to the later versions which are following it.

The F-105B Thunderchief is a single-seat day fighter/bomber. Powered by a J75-P-5 (the first batch were originally fitted with the P-3 engine), it has an internal weapons bay, four wing pylons and a fifth external attachment under the bomb bay, an M-61 "Gatling gun," an autopilot, integrated radar fire control and provision for in-flight refuelling.

In general, the structure of the 105B is remarkably conventional. Integrally stiffened skins and honeycombs seem to be conspicuous by their absence, and traditional methods of manufacture are employed wherever practicable. The ruling material is 75ST aluminium alloy, and steel, titanium and magnesium alloys are restricted to localized areas where these materials can show distinct advantages. The airframe is sub-divided into major portions, each made in a separate part of the Farmingdale plant (there is practically no sub-contracting) on what is generally known as the "colony" system. Port and starboard wings, for example, leave their colony in a virtually completed state. The system will be referred to again as the description of the aircraft proceeds.

Although its fine lines and fighter-type canopy belie the fact, the fuselage has a length of over 63ft; this is twice the length of a Vampire and comparable with the body of a Canberra. For production purposes the fuselage is broken down into nose section, centre fuselage, rear fuselage and aft section, each of which is manufactured in its own colony. The nose is relatively conventional, this portion being built up from approximately circular frames of various sections held together by heavy longerons. Eventually the entire nose is filled with weapon-system equipment, so that more than half of its surface consists of dielectric areas and access hatches. At the rear is the roomy cockpit, with a pressure-bearing floor built up from transverse and longitudinal beams. Beneath this floor is the bay for the nose undercarriage, which retracts in a forwards direction.

The centre fuselage is built up from partial frames and angle-section stringers, the latter being broken fore and aft of the main frames. On the underside is the weapons bay, with its twin upward-hinging doors. Amidships are the winglets, which form an integral part of the fuselage and intake structure. The heaviest loads in the entire aircraft are accommodated by the main frame and the forward H-frame, both of which are machined from massive forgings in high-strength steel. Kearney & Trecker three-axis millers are used on these forgings, with Bendix digital tape control. The root rib along either side is machined on a converted Cincinnati spar mill with rising and falling cutters. This root rib is pierced by the main frame at station 442 and forms the outer boundary of the winglet and duct sub-assembly.

The rear fuselage cross section increases from front to rear

to conform to the area ruling, and within it are housed the majority of the aircraft's basic accessory systems. It is worth noting that a special tool is employed to ensure a good fit at the splice between this section and the centre fuselage (and between the centre fuselage and the nose). When the two mating portions are brought together, a small surplus is left on the adjacent skinning and this is trimmed off both sections simultaneously by a pair of circular saws, which are ganged together to produce a close-tolerance cut. When trimmed, the two portions of fuselage can be wound together and joined by a double line of heavy countersunk rivets. The aft fuselage is relatively conventional and is made in a rotatable jig. As it must be readily removable for powerplant changing it is attached to the rear fuselage by four bolts at the main longerons.

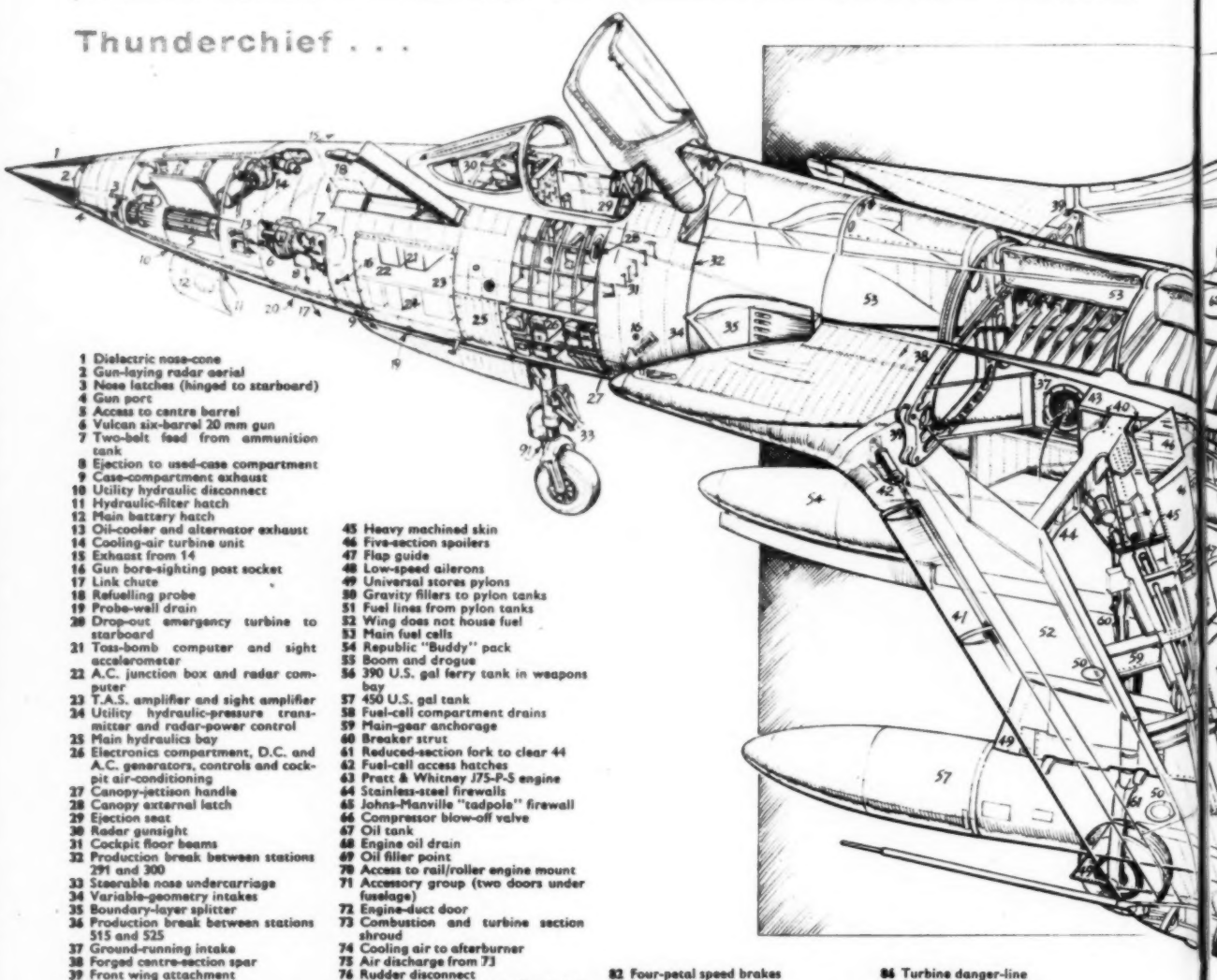
Both port and starboard wing structures are quite straightforward. There are two principal spars running from root to tip, and a lighter spanwise member runs between them. At the root the immense loads are taken by a chordal member known as the transverse spar. This is forged in 75ST and is then machined on a tape-controlled Kearney & Trecker. A similar machine is used to profile the caps (booms) above and below the front and rear spars. Both of the latter are machined to close tolerances as flat slabs of 75ST, after which they are forged by the Wyman-Gordon Company to the correct compound curvature and quenched in the die. Nearly all the inboard wing structure is covered by a machined skin, which is likewise pressed to the required contour before being attached by heavy bolts and flush rivets.

A considerable proportion of the inner wing is occupied by the main undercarriage legs. The lower portion of each leg is machined from very high-strength steel, to permit its section to be small enough to lie beneath a recessed portion of one of the forged wing chordal members. The retracted wheel occupies the innermost portion of the wing, immediately to the rear of the intake duct. The skin above the cut-out is stabilized by a bonded "waffled" inner skin. The whole design is extremely neat, and the fact that the intake ducts run diagonally through the inboard portion of each wing provides sufficient depth for stowage of the undercarriage entirely outside the fuselage, thus leaving the latter free for the weapons bay.

In order to provide the maximum possible lift and minimum drag under all conditions of flight, the leading edge is contoured to a conical-camber profile, in which the camber of the wing (and the percentage chord at which camber starts) increases progressively from root to tip. Moreover, the entire leading edge is hinged and can be mechanically depressed to prevent separation of flow at high angles of attack. From the wing root to the aileron on each wing is mounted a single section of slotted flap. These flaps are mounted on tracks and are wound out by screw-jacks driven by hydraulic motors. A portion of the trailing edge of each flap is hinged to the main flap surface, and as the latter is depressed the secondary portion is pulled upwards so that it does not foul any of the variety of large stores that can be carried beneath the wings.

Perhaps surprisingly, Republic have not attempted to put fuel inside the Thunderchief wing; doubtless this will form some potential inbuilt "stretch" for future versions. The complete wing

Thunderchief . . .



1 Dielectric nose-cone
2 Gun-laying radar aerial
3 Nose latches (hinged to starboard)
4 Gun port
5 Access to centre barrel
6 Vulcan six-barrel 20 mm gun
7 Two-belt feed from ammunition tank
8 Ejection to used-case compartment
9 Case-compartment exhaust
10 Utility hydraulic disconnect
11 Hydraulic-filter hatch
12 Main battery hatch
13 Oil-cooler and alternator exhaust
14 Cooling-air turbine unit
15 Exhaust from 14
16 Gun bore-sighting post socket
17 Link chute
18 Refuelling probe
19 Probe-wall drain
20 Drop-out emergency turbine to starboard
21 Toss-bomb computer and sight accelerometer
22 A.C. junction box and radar computer
23 T.A.S. amplifier and sight amplifier
24 Utility hydraulic-pressure transmitter and radar-power control
25 Main hydraulics bay
26 Electronics compartment, D.C. and A.C. generators, controls and cockpit air-conditioning
27 Canopy-jettison handle
28 Canopy external latch
29 Ejection seat
30 Radar gunsight
31 Cockpit floor beams
32 Production break between stations 291 and 300
33 Steerable nose undercarriage
34 Variable-geometry intakes
35 Boundary-layer splitter
36 Production break between stations 515 and 525
37 Ground-running intake
38 Forged centre-section spar
39 Front wing attachment
40 Rear wing attachment
41 Conical-camber hinged leading edge
42 Actuator for 41
43 Transverse spar
44 Forged bridge-member
45 Heavy machined skin
46 Five-section spoilers
47 Flap guide
48 Low-speed ailerons
49 Universal stores pylons
50 Gravity fillers to pylon tanks
51 Fuel lines from pylon tanks
52 Wing does not house fuel
53 Main fuel cells
54 Republic "Buddy" pack
55 Boom and drogue
56 390 U.S. gal ferry tank in weapons bay
57 450 U.S. gal tank
58 Fuel-cell compartment drains
59 Main-gear anchorage
60 Breaker strut
61 Reduced-section fork to clear 44
62 Fuel-cell access hatches
63 Pratt & Whitney J75-P-5 engine
64 Stainless-steel firewalls
65 Johns-Manville "tadpole" firewall
66 Compressor blow-off valve
67 Oil tank
68 Engine oil drain
69 Oil filler point
70 Access to rail/roller engine mount
71 Accessory group (two doors under fuselage)
72 Engine-duct door
73 Combustion and turbine section shroud
74 Cooling air to afterburner
75 Air discharge from 73
76 Rudder disconnect
77 Rear-fuselage disconnect (four bolts)
78 Rudder actuator compartment
79 Afterburner fuel injectors
80 Con-di nozzle actuators
81 Tailplane fulcrum
82 Four-petal speed brakes
83 Speed-brake actuators
84 Brake petal depicted in cruise position
85 Pneumatic-tube practice-bomb dispenser
86 Turbine danger-line
87 Braking-parachute box
88 Access to aerial cable
89 Buzz dampers
90 Lifting points
91 Taxying lamp

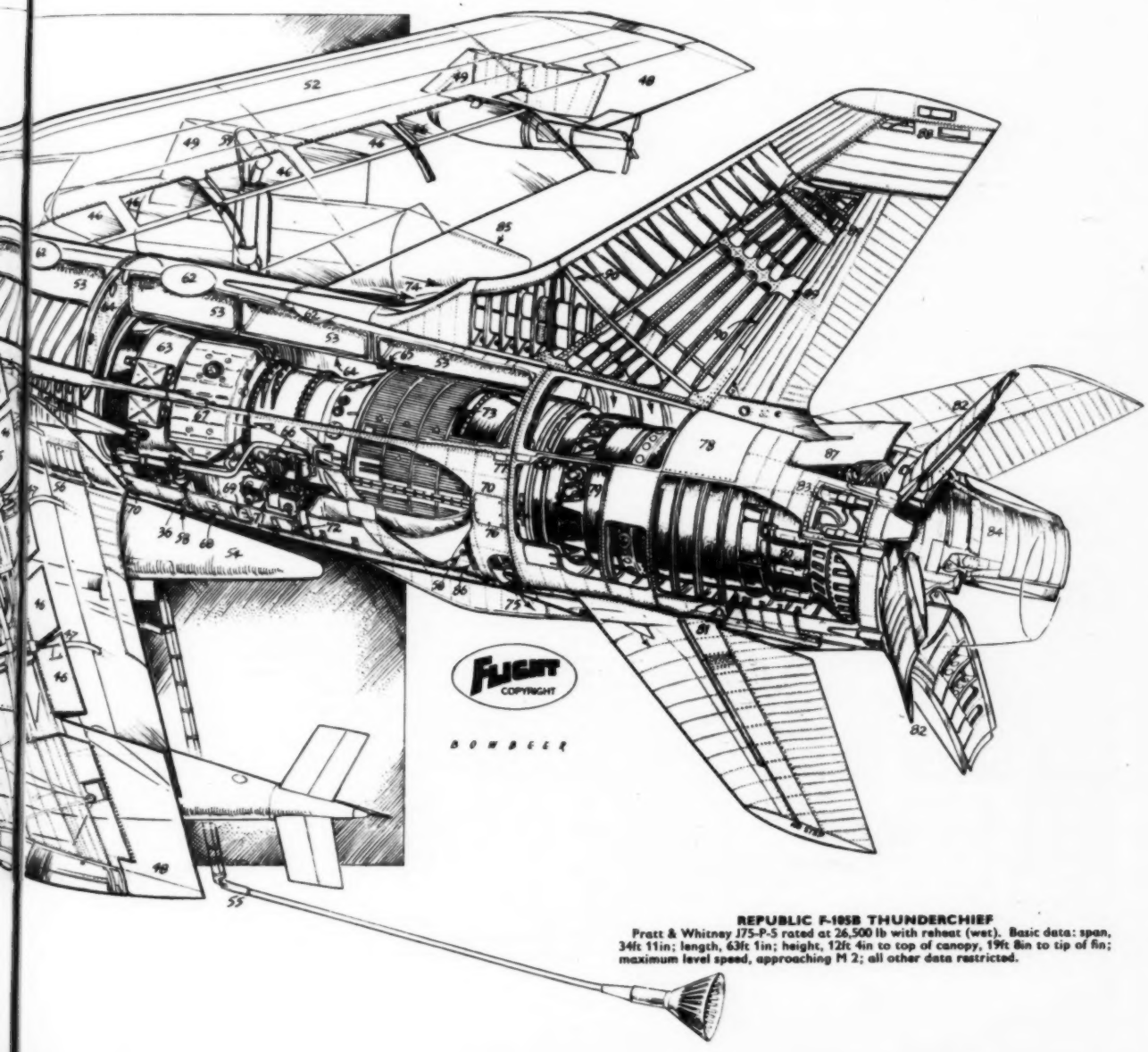
units are built up in jigs with their magnesium-alloy tips, tip lights, wiring, drop-tank gear, pylon attachments, undercarriage units, all movable surfaces and actuators, fuel piping and valves, and pitot systems. The final unit is then mounted in a rotating jig and subjected to full functional testing before delivery to the erection line.

All flying controls of the Thunderchief are fully powered and irreversible. The rudder is a single surface devoid of tabs; it has slightly inset hinges, a mass balance at its upper end and hydraulic actuation at its lower end, a buzz-damper being provided to prevent flutter. The horizontal tail comprises a pair of single slabs; "stabilator" is the accepted term at Farmingdale, since each surface combines the functions of stabilizer (tailplane) and elevator. Port and starboard slabs are brought together, and joined by a flash-welded steel tubular cross-beam, which is kinked downwards to clear the afterburner tailpipe. The jointing, and in particular the drilling of the large holes in the 75ST root fittings on each slab, is conducted to very close tolerances, and special jigging is employed to ensure compliance. The slab root attachments are, in fact, heated and shrink-fitted over the ends of the cross-beam. The complete assembly is then offered up from beneath the aft fuselage, and is actuated by a tandem hydraulic jack.

Primary control in the rolling plane is provided by five sections of spoiler on each wing, which are inched hydraulically in an infinitely variable manner. Conventional ailerons are also employed, sequenced into the same circuits as the spoilers but taken out of circuit at high indicated airspeeds.

Particular interest attaches to the speed brakes. These four surfaces form the rearmost three feet of the fuselage, and variation in their position also affects operation of the powerplant. When fully closed, the four sections provide a convergent/divergent nozzle to produce maximum thrust and fuel economy under normal flight conditions. To provide high deceleration in the air either two or four of the hinged petals can be pulled forwards hydraulically. In the landing configuration the two lateral panels only are employed, since these provide adequate drag for balancing against high engine r.p.m., leaving a large excess of thrust available should the aircraft have to overshoot; the upper petal cannot be used, since it would foul the braking-parachute cable, and the lower petal would touch the ground. For maximum air deceleration and for emergency descent from high altitude all four petals can be opened fully. Republic believe they produce higher drag, with less buffet or trim change, than any contemporary speed-brake system.

Turning next to the undercarriage, it is fair to assess this as a particularly outstanding example of the mechanical engineer's art. A product of Bendix Aviation Corporation, each main leg comprises a vertical shock strut carrying at its lower end a cantilever of high-strength steel which passes outboard of the single wheel. Multi-pad Goodyear brakes with anti-skid are employed, served by flexible piping. Each main leg carries a landing lamp and is retracted inwards by a hydraulic jack attached to the breaker strut. The nose gear carries a single wheel in a fork fitting and is hydraulically steerable under the control of an automatic system which provides a closed-loop servo between the nosewheel and the pilot's pedals. The nose gear carries a steerable taxying lamp



REPUBLIC F-105B THUNDERCHIEF

Pratt & Whitney J75-P-5 rated at 26,500 lb with reheat (wet). Basic data: span, 34ft 11in; length, 63ft 1in; height, 12ft 4in to top of canopy, 19ft 8in to tip of fin; maximum level speed, approaching M 2; all other data restricted.

Thunderchief . . .

and retracts in a forwards direction into an unpressurized box.

Sole source of propulsion in all current F-105s is the single J75 turbojet. As already noted, the F-105B is at present fitted with the J75-P-5, which has a dry rating of approximately 16,000 lb, and a maximum thrust of some 24,500 lb with the afterburner in operation and 26,500 lb with water injection as well. The engine air is inhaled through ducts of subtle profile.

For an indication of the geometry of these ducts, the reader is referred to the cutaway drawing as their design is not readily described. An aerodynamicist will appreciate the neatness with which the oblique shocks are kept away from the fuselage and wing, while the normal shock is precisely positioned at the optimum point in the inlet by a variable-geometry system controlled by mechanisms produced by Lear Inc. The exact method of control is classified, but it seems fairly obvious that it involves changes in the profile of the interior wall of the duct and possibly control of the pressure difference across the bleed ports on the inner wall. Finally, the two ducts emerge at the intake face of the engine. For ground-running purposes there are additional gauze-protected intakes within the wheel wells. Cooling and venting of the powerplant bay is assisted by flush N.A.C.A.-type inlets at various points on the fuselage.

At the base of the leading edge of the fin is a ram intake to ducts which pierce the vertical ribs and steel spar of the fin and then curve downwards to feed air into the rear fuselage. This flow cools the afterburner and its shroud and provides a substantial ejector airflow between the variable nozzle of the engine and the convergent/divergent inner walls of the speed brakes to provide a valuable increase in effective thrust. Under normal flight conditions the four speed-brake petals form a continuous unbroken nozzle, each section having sprung edge-flaps which press against those of its neighbours. Inconel has to be used to skin the inner surface, notwithstanding the high secondary (ejector) airflow. The Inconel is put on in transverse strips which are allowed to overlap and ride, one over the other, according to the temperature of each portion.

Owing to its great size, the Thunderchief fuselage can accommodate a very large quantity of fuel. The main tanks are flexible cells, which are mounted in smooth-walled boxes above the intake ducts in the centre fuselage. An additional 390 gal ferry tank can be accommodated in the weapons bay and a variety of tanks may be suspended beneath the wings. Range during a mission can be increased by as much as 70 per cent by in-flight refuelling. The retractable probe is mounted on the port side of the forward fuselage; and the tanker may, in fact, be another Thunderchief, using the Republic-developed and manufactured "buddy" package. This takes the form of a streamlined underwing pod housing a mechanically actuated rigid boom and flexible trailing hose and drogue. Unlike the majority of such buddy packages, the Republic unit also contains fuel in the upper half of the nacelle.

It should already be clear that major accessory loads in the F-105 are borne by the hydraulic system. Vickers Inc., a Division of Sperry Rand Corporation, is prime contractor for the majority of the hydraulic components, which include 3,000 lb/sq in variable displacement piston-type pumps and an additional constant-displacement pump driven by the drop-out ram-air emergency turbine in the forward fuselage. Westinghouse supply most of the electrical equipment. Primary loads are generated by two MB-3 30 kVA alternators driven by Sundstrand variable-ratio drives from the main powerplant. These feed the A.C. system through 3-phase regulators providing primary power to all parts of the airframe. D.C. current at 30V is supplied by a Bendix (Red Bank Division) MA-11 generator.

Weapon-system equipment is officially classified, but much can be gleaned by studying the advertisements of the sub-contractors who supply it. The basic flight-control system of the F-105B is the FC-5 produced by General Electric's Light Military Electronic Equipment Department at Utica, N.Y. This versatile system can operate as a single-axis damper or as a fully automatic control system linked to bombing, fire-control, navigation and ground control systems. Also from LMEED (but from Johnson City, N.Y.) is the MA-8 fire-control, which incorporates radars, an automatic lead-computing sight, a toss-bombing computer and other portions to handle "all methods of attack." Bendix (Eclipse Pioneer) supply the central air-data computer, signals from which provide an integrated source of altitude, A.S.I. and temperature information for the functioning of the entire weapon system. From Collins Radio come the modular electronics, comprising U.H.F. comm., Tacan RF, Tacan nav. instrumentation, power supply/ADF and ILS/intercom.

An accompanying photograph depicts the majority of the vast assortment of weapons with which the F-105B can be armed. Apart from the "black boxes," the only built-in portion of the armament system is the General Electric M-61 Vulcan gun. Republic have designed for this formidable piece of ordnance a special two-belt feed system, which provides two simultaneous feeds from the ammunition tank and enables the gun to realize its full potential rate of firing of 6,000 rounds per minute. In other installations with single-belt feeds (such as that in the F-104 described in our issue of May 30, 1958) the rate is appreciably lower. The M-61 can be electrically or hydraulically driven, and the latter method is normally employed in the F-105B.

The foregoing refers specifically to the F-105B. Nearly all Thunderchiefs so far delivered have been of this model, and all are employed by the U.S. Air Force Tactical Air Command as day fighter/bomber aircraft. The first F-105 unit was the 335th F/B squadron, who began to receive aircraft last autumn. Several wings are now working up to operational standard, and the aircraft is proving immensely popular owing to its flashing performance, versatility and tractability. At least one squadron, and possibly a complete wing, is likely to be deployed in the European theatre before the end of the current calendar year.

Originally money was voted for a reconnaissance version designated RF-105B, and this aircraft would have carried a KS-27A camera system and a great deal of other reconnaissance equipment in a nose of revised profile. However, in view of the existence of the McDonnell RF-101A Voodoo and a variety of possible pilotless reconnaissance systems, the requirement for a camera-equipped Thunderchief lapsed. The RF prototypes were converted to the JF-105B configuration to act as "test vehicles for systems components."

Next in alphabetical order would have come the 105C tandem trainer, but this has not been completed and current production is concentrated upon the F-105D. Although externally almost indistinguishable from the 105B, the D model incorporates a large number of internal improvements which significantly increase its efficiency and versatility. A single-seater, it is nevertheless capable of genuine all-weather operations and is officially classed as an AW fighter/bomber.

In the 105D the standard powerplant is the Pratt & Whitney J75-P-10, in which dry and reheat wet ratings are both increased by some 10 per cent. The advanced ASG-19 radar fire control is incorporated, including the NASARR monopulse radar, by the Autonetics division of North American Aviation. Another wholly new system incorporated in the 105D is the APN-105 doppler radar installation produced by the Laboratory For Electronics. Associated with this system is an Earth-rate directional reference.

Further new systems in the D model include the Wright Air Development Center Phase II instrument panel, which incorporates vertical-scale flight instruments by the Eclipse Pioneer Division of Bendix; Collins Radio supply the flight-director computer system and horizontal situation indicator.

There was to have been an F-105E tandem-seat all-weather fighter/bomber, but financial considerations caused this order to be rescinded early this year and replaced by procurement of an additional quantity of 105Ds. Engineering and production development of the two-seater would have required an additional appropriation of many millions of dollars, and it was not felt that the inclusion of a navigator warranted such an outlay.

Republic are not at present able to deliver 105s at anything like the rate of which the factory at Farmingdale is potentially capable, since the overall order has been stretched over a considerable period. Nevertheless, each Thunderchief represents an offensive and defensive vehicle of remarkable potentiality, far surpassing that of any previous aeroplane of equivalent size.

After much posing at Farmingdale this photograph depicts some of the Thunderchief's armament; keen-eyed readers may find the M-61 gun and 20 mm ammunition; 2.75in rockets; 750 and 1,000 lb bombs; chaff dispenser; Sidewinders; Buddy pack; 450-U.S. gal drop tanks; nuclear stores (shrouded); and an array of electronic boxes

Straight and Level

AN American company, Gulf Oil, wanted to land its Convair at London Airport. The request was answered as follows:—

". . . Sympathetic consideration has been given to your application but I regret to inform you that because of the heavy incidence of scheduled traffic at the times of the proposed movements on the days in question the General Manager is unable to give you the permission you seek. . . ."

Commenting on this, the American AOPA (Aircraft Owners and Pilots Association), says:—

"The facts: Latest annual traffic count for London—129,497 plane movements, putting it between Orlando, Fla (rank No. 83 among 196 U.S. airports with control towers), and Little Rock, Ark (rank No. 82).

"Chicago Midway movements (rank No. 1) outnumber London 3.3 to 1; Teterboro, N.J. (rank No. 16, with no airline operations on field) outnumbers London 1.9 to 1. No U.S. airport has such restrictions.

"The British frequently dominate international conferences on the contention that they're experts on traffic density, congestion, need for control, etc. Meanwhile, the Gulf Convair, carrying the Corporation's president, was forced to fly to an outlying airport."

The AOPA obviously has not heard of the Croydon Airport Doctrine—which is to the effect that British air traffic control is the master, not the servant, of aviation.

● Can anyone tell me where I can get Sheet N.E.50/1, the I.C.A.O. 1 : 500,000 map of the Low Countries? The Royal Aero Club, who are normally able to supply maps for Continental air touring by return of post, say that this sheet has been unobtainable for a year. The publishers—the Ministry of Transport and Civil Aviation—seem to have little idea of when a revised sheet will be available, and meanwhile I must use a borrowed copy published by the War Office in 1950 and now obviously—and perhaps perilously—out of date.

Is this the latest sinister plot by the M.T.C.A. to embarrass private flying? Or is it that the Low Countries are all below sea level, and so come under the province of the Ministry of Agriculture and Fisheries?

● My word, the *Daily Clanger* has started something. On Monday the front-page headline was: "BRITAIN'S WONDER PLANE IN TROUBLE"—and the wonder plane, as of course you must know, was the projected Scruggs S.A.394 Speedmaster.

This project, said the story, was to be cancelled, and thousands of Scruggs workers sacked, because the firm had suddenly realized that the aeroplane's estimated weight had doubled, speed and range had halved, cost had trebled, and delivery-date had gone back five years.

". . . and I was all set to do a test ejection on the tower at R.C.A.F. Portage La Prairie when I realized I'd left my bone-dome in the mess. So I figured this was the only thing to do. Now, will someone pull the blind for me, please?"

"A major row is raging," the story continued, "between Sir John Blackout-Jones, boss of Scruggs, and Sir Charles Boost, chief of Plummet Air Lines, who has 75 Speedmasters on order. I understand," added the *Clanger's* reporter, "that Sir Charles has told Scruggs that unless his Speedmasters are delivered next year he will cancel them and buy American planes."

● A statement issued the following day, signed jointly by Sir John Blackout-Jones and Sir Charles Boost, said:—

"Our attention has been drawn to a report in the *Daily Clanger* that the project Scruggs S.A.394 Speedmaster is 'in trouble,' that it is to be cancelled, and that Scruggs's workers are to be declared redundant.

"This report is completely false, untrue and without any foundation whatsoever, and it is categorically denied in its entirety and on every count. The Speedmaster programme is years ahead of schedule, the aircraft is confidently expected to exceed estimates, and, as for redundancy, Scruggs are about to launch a nation-wide staff-recruiting programme."

● At the bottom of page 6 of Wednesday's *Clanger* appeared the following statement: "PLANE CHIEFS DENY TROUBLE: Reports that Britain's new superjet Speedmaster is delayed were last night denied by a spokesman for Scruggs, builders of the plane."

● The other day a British test pilot was asked by a journalist what he thought about three-pointer altimeters. "I have never misread one," he said, "or even nearly misread one. But that's not to say I might not misread one this afternoon or tomorrow."

Which, I think, is the most reasonable remark I've yet heard on this tricky subject.

● The orange Day-Glo paint which embellishes *Flight's* Gemini attracts just about as much attention on the ground as it does when airborne. At the recent display at Shoreham dozens of small boys peered at the paint, rubbed it, and got close enough to it to lick it off like a lollipop.

Only one boy was really practical. He draped his coat over one of the fins and got underneath to see if it really does glow in the dark.

ROGER BACON

Yes, U. S. A. F. armoured cars; and they're awaiting disposal at Burtonwood, that sprawling erstwhile boom-town of some 30,000 souls in Lancashire—now a desolation.

I know that long ago the R.A.F. used to do some brisk business with armoured Rolls-Royces in the Middle East. But then the natives didn't even pretend to be friendly.

I am wondering if the U.S.A.F. brought these Chicago bank-wagons as protection against the treacherous Picts, the marauding Scots or the perfidious Albions.

Off the line at Boeing's Renton division rolls 707 number 50—a model 120 for American Airlines. Meanwhile the first Douglas DC-8 has been delivered—to the schedule published on this page two years ago—to United Air Lines, who will use it for training prior to services in September. Temporary loss of the second DC-8, badly damaged in a heavy landing, will not affect the certification programme

AIR COMMERCE

B.O.A.C. FORGES AHEAD

TOWARDS the close of last year's summer season it became apparent that B.O.A.C. was likely to oust T.W.A. from their long-held position of number two across the North Atlantic. The last quarter of 1958 saw B.O.A.C. take the lead (*Flight*, April 24).

Statistics for the first quarter of this year now show that the British carrier has forged convincingly ahead of its American rival.

Compared with T.W.A.'s passenger total of 18,000, B.O.A.C. lifted no less than 28,000 passengers across the North Atlantic in the first three months of this year. The Corporation's figures incorporate Canadian traffic, but if this is excluded the U.S. operator is seen to have carried over 4,000 passengers fewer than B.O.A.C. on the U.S. - Europe routes.

To put these carriers' traffic into perspective, PanAm carried no less than 54,000 passengers during the first quarter. This figure —which is equivalent to 28 per cent of the total market—is about double the Corporation's traffic.

Footnote: Last week B.O.A.C. announced that Comet 4 services to New York are to be increased from daily to 12-times-weekly frequency by the end of June. There will also be two jet services per week to Montreal, instead of just one, as from mid-June.

MALTA SAYS YES

THE air licensing authority of Malta, having heard the case for and against Eagle's "V.L.F." £19-return application (see summary in *Flight* for May 22), has decided to approve the application. This follows the approval of similar V.L.F. applications by the Hong Kong and Aden authorities. A decision by the Minister of Transport is, of course, still awaited: the recommendations of the A.T.A.C.—whose private hearings into the Eagle and Airwork/Hunting-Clan V.L.F. applications involved sittings lasting a record 20 hours—were made early in May.

The "status" of the other applications in the other Colonies concerned is as follows: Cyprus, Nairobi and Nassau—hearings completed, but no decision announced. Singapore (whose air rights are still the responsibility of the U.K. despite independence) and Gibraltar have no air licensing boards; the V.L.F. applications to these points were heard by the A.T.A.C.

—AND MORE "V.L.F."

DESPITE talk about the vast size of the short-haul market, the most important untapped routes to the U.K. are those from Australia and South Africa. These two are the only major routes on which the air share of the total pasesenger movement is less than 20 per cent.

A recently announced effort to penetrate the South African market is an £87 10s fare (£67 10s in the off-season) between Luxembourg and Lourenço Marques. (The circuitous routing via Lisbon is dictated by the need to secure traffic rights.) Making allowance for connecting services at either end, it thus becomes startlingly possible to travel between London and Johannesburg for about £100—saving more than £50 on the existing tourist fare. This service will be operated by a new company, Trans Africa Air Coach.

Trans Africa Air Coach is closely associated with Overseas Aviation (whose newly acquired Argonauts will be chartered for this operation) and with the Overseas Club, a social and residential club in London which caters especially for younger South Africans.

Here is the Vickers Vanguard after its second overseas flight—at Brussels, where it was inspected by Sabena. Next day, June 4, it flew to Rome, where it was inspected by Alitalia. All three flights (the first was to Hamburg) have been spot on schedule, and in "jet" block-times —2 hr 27 min to Rome, for example

THE LAST OF B.O.A.C.'s CONNIES

MORE information is now available about B.O.A.C.'s successful disposal of its L.749 Constellations. The acquisition of four by Skyways, reported last week, completed the sale of all 16.

Price paid by Skyways will not be disclosed; it is said by B.O.A.C. to be "under negotiation." Nor have the values of the other 749 sales been disclosed; but an average figure of about £100,000 each might be of the right order.

Skyways will take 'LAX, 'LAL, 'NUP and 'NUR; the first two will be delivered in a few days' time prior to the cargo conversion-work reported last week. The first Connie to be sold was 'NUX to Pacific Northern in April 1957; two more were bought by that operator; two by Capitol; two by Transocean; two by the Babb Co.; and three by Avianca.

PROMOTING THE ELAND CONVAIR

THE promotion of the Canadair 540 in recent months has been quite remarkably intense; a powerful world-wide advertising campaign has been backed up by an 80,000-mile (to date) series of demonstration tours, and this week a promotional peak will be reached at the Paris Show. The very first Eland-Convair, the 340 converted by Napier at Luton in 1955, will return to Europe after its two-year flight test programme in America for the Paris Show, and for a subsequent series of European demonstrations.

Meanwhile two other Eland Convairs, the 440 converted by Canadair and the 440 converted by PacAero, have successfully completed—on schedule—ambitious tours of North and South America. One aircraft visited more than 40 cities in America and Canada over a ten-week period. The other visited every country in South America except one over a four-week period.

Starting on July 1, Allegheny Airlines of Washington D.C. will begin regular passenger-carrying schedules with a leased Napier Eland Convair on its routes to Atlantic City and Pittsburgh from Washington.

THE TOKYO DISPUTE

AS this issue went to press the C.A.B. sent to the White House for Presidential approval their final decision about B.O.A.C.'s right, under the U.K.-U.S.A. Bermuda air agreement, to include Tokyo on its Hong Kong—San Francisco route.

A brief recapitulation of the complex situation is called for. It will be remembered that B.O.A.C. prematurely inaugurated a service on this route (thus completing their round-the-world service) on April 1. It was discontinued when the C.A.B., in the face of Northwest Airlines' allegation that the service would not be in the American public interest, withheld approval which—it had been supposed by B.O.A.C.—was implicit in the U.K.-U.S. air agreement as revised in 1957.

For the reasons previously put forward in these pages it will be extremely surprising if B.O.A.C.'s traffic rights in Tokyo are not upheld by the C.A.B. and the President. If they are not, the air agreement between the two countries will be worth less than the paper on which it is written. And at the back of everyone's mind is the ugly possibility of British reprisals. The Minister of Transport has actually talked about the possibility of "reviewing" the air rights of the Americans. The reason why Pan American have avoided being drawn into the controversy is probably not unconnected with their enjoyment of valuable rights at Hong Kong.

Meanwhile, with little publicity, the Japanese appear to have been doing some bargaining with the United Kingdom. Talks which ended in Tokyo on May 28 ("affirming an existing understanding") suggested that B.O.A.C.'s April 1 inaugural may have been premature so far as the Japanese, as well as the Americans, were concerned. The outcome of the talks, which lasted three weeks, was that J.A.L. can now operate a daily service between Tokyo and Hong Kong—an increase of two services per week. B.O.A.C. and Cathay Pacific were "confirmed in their rights" to serve Tokyo from Hong Kong on to, respectively, San Francisco and Australia.

AIR COMMERCE . . .

JUST HAVING A GANDER

CUSTOMS officials at Gander, Newfoundland, have levied fines of $100 and $150 respectively on B.O.A.C. and PanAm. Under the quarantine regulations airline passengers in transit must be conducted by a steward or a stewardess to a "health desk," where vaccination certificates must be shown, before they enter the airport lounge or restaurant for refreshments. Both airlines, it was alleged, had allowed passengers to wander around the new airport without being checked by the airport's health department officials.

In line with the modern concept, the flight deck of the Tu-114—of which this is one of the first photographs to be published—appears to have "swing - down" equipment

I.C.A.O. BOARD MEETING

ON June 16 at San Diego the Assembly of the International Civil Aviation Organization will meet in major session for the first time since the 1956 meeting at Caracas, Venezuela. This will be the twelfth meeting since the Organization was founded. Member States will assess the work of I.C.A.O. over the past three years on air navigation, air transport, air law, and technical assistance and plan the programme for the future. A new council will be elected (consisting of 21 member States of chief importance to air transport) and a new president chosen to succeed Dr. Walter Binaghi of Argentina.

Full sessions of I.C.A.O. are conducted with a degree of ceremony befitting the status of the Organization, but they also provide cohesion for its many-pronged administrative and technical efforts in civil aviation. Following the first plenary meeting —which includes an official welcome by the host State—there are to be meetings of the executive committee and the technical, economic and legal and administrative commissions. On the agenda for the last-named is apportionment of expenses among contracting States; although individual contributions are unlikely to diminish, the work of I.C.A.O. is still supported on little more than $3 million a year from its 74 member States.

B.E.A.'s LAST POOL

AN agreement between B.E.A. and Transportes Aéreos Portugueses for technical and commercial co-operation on the London - Lisbon route completes B.E.A.'s policy of pooling with its western rivals. Since agreements with Air France and Swissair came into operation on April 1, T.A.P. has been the sole exception to the Corporation's policy of pooling services with its 14 European competitors, although even at that time an arrangement was under contemplation. There is no pool with Aeroflot.

As from last Tuesday, June 9, T.A.P. were to use B.E.A. Viscounts on all their services, so releasing their Super Constellation 1049Gs from this 937 st. mile route and making them available for an expansion of the Portuguese African services. The Viscounts are to be chartered from the Corporation but will be operated in B.E.A. colours and by B.E.A. crews; scheduling will be rearranged to provide for a daily morning departure from London and afternoon departure from Lisbon instead of alternate morning or afternoon departures from each airport on successive days as formerly. By not later than next spring the two airlines will introduce night tourist services and fares, which have not previously been available between London and Lisbon.

BREVITIES

A world-wide policy of eliminating tipping was announced at I.A.T.A.'s spring traffic conference at Burgenstock, Switzerland.

* * *

Pacific Western Airlines have been evaluating the Convair 540 on various routes from their base at Edmonton.

* * *

An inter-line agreement has been signed between K.L.M. and Derby Aviation to enable direct bookings to be made from Derby to New York. Twice-weekly services from Derby to Prestwick connect with K.L.M. flights from Schiphol.

* * *

An Air France Caravelle recently took off fully loaded (with journalists and technicians) on one engine at 83,115 lb. At 40,000ft over Paris, both engines were throttled back, and the aircraft glided the 164 miles to Dijon, where it arrived 49 minutes later at a height of 5,200ft.

Looking ahead to Allegheny Airlines' three-month evaluation of the Eland-Convair, executives of the company (including the president, Mr. L. O. Barnes) recently visited the Napier works at Acton to see Eland production. Here, left to right, Sir Archibald Hope and Mr. H. Sammons—respectively Napier director of sales (air) and managing director—are showing reduction-gear components to Mr. Dixon Speas, an independent consultant employed by Allegheny

I.A.T.A. airlines lost about £42,740,000 in 1958, according to the I.A.T.A. annual report—three times as much as in 1957.

* * *

Sir Victor Tait, chairman of International Aeradio, has been elected a Board member of the Flight Safety Foundation.

* * *

American Airlines lost $1,977,000 in the first quarter of 1959, according to C. R. Smith, the airline's president; the loss was offset by $1,129,000 from the sale of property.

* * *

Mr. E. R. Quesada, administrator of the F.A.A., has undergone a five-day jet transport training course on KC-135s at a U.S.A.F. school.

* * *

The contract between Air Trainers Link and Aerolineas Argentinas for synthetic flight trainers is valued at £150,000 not $150,000 as inadvertently stated previously.

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Ansett-A.N.A. have opened an office in London. The address is Albemarle House, Corner of Albemarle Street and Piccadilly, London, W.1 (telephone, Hyde Park 0303).

* * *

The American Government has decided that turboprop conversions (e.g., Napier Eland Convair) are eligible for government-guaranteed loans under the Air Carrier Loan Act of 1957, which was designed to help local-service airlines to finance new equipment.

* * *

I.A.T.A. membership has been increased to 88 with the addition of Sudan Airways as one of 80 active members. Last Monday Sudan were to start a weekly Viscount 831 service between London and Khartoum with stops at Rome, Athens and Cairo. The aircraft is maintained and crewed by Airwork.

* * *

The C.A.B. investigation of the accident to Capital Airlines' Viscount in Michigan on April 6, 1958, intimated that the airliner probably stalled during a steep turn, and fell to earth nose first. The report said that the stall-warning device was not working, and that the aircraft might also have accumulated ice.

* * *

Cory Brothers & Co. Ltd., of Cardiff, announce that they have received an order from Vickers-Armstrongs (Aircraft) Ltd. for 60 Elliot inflatable escape chutes for the 20 T.C.A. Vanguards—three per aircraft. The chute slide is supported by two tubes inflated by a Walter Kidde aspirator in conjunction with a lightweight vessel by Bristol-Aerojet Ltd.

Among the R.A.F. contingent will be the renowned Hawker Hunters of "Treble One" Squadron with a repertoire including new manoeuvres

Britain's Contribution to the Paris Show

BRITISH industrial representation at the 23rd Salon International de l'Aéronautique (which, in terms of scale, technical interest and spectacle, promises to be the most notable event of its kind ever organized) is a worthy one. That will immediately be evident from perusal of the following pages. And supporting the industry's own contribution will be the Royal Air Force, showing the flag over Le Bourget with the immaculate aerobatic manoeuvres of the famous "Treble One" squadron of Hawker Hunters and with examples of each of the V-bombers—Handley Page Victor, Avro Vulcan and Vickers Valiant. The R.A.F. will also be displaying a Gloster Javelin FAW.7 and a Hunting Jet Provost.

Acratork Engineering Co. Ltd. (Stand No. 22A) Through its agents in France—compagnie Française Powell Duffryn—this company is again exhibiting its range of torque loading equipment. Acratork equipment comprises a range of spanners and wrenches providing for all torque loads from 4 oz-in to 850 lb-ft and a variety of test and setting rigs for torque spanners of all types. In addition a hydraulic torque generator, which applies torque loads of up to 3,000 lb-ft, is available.

Acratork equipment is widely used throughout the aircraft industry both in the U.K. and in Europe. It is fully approved and is being increasingly employed in guided missile assembly.

Air Engine Services (Stand No. 40A) This company will show a Pratt & Whitney R-1340-40 engine after complete overhaul at their works and built up as an engine change unit ready for installation in a Westland Whirlwind helicopter. There will also be a display, by their associate company Air Engine Parts Ltd., of Pratt & Whitney engine parts representing a few of the items of the large inventories of P. & W. spares of which they are stockists.

Air Engines Services, Blindley Heath, Lingfield, Surrey.

Alvis Ltd. (Stand No. 67A) Alvis will be showing a Leonides Major engine for fixed-wing applications (Type 702/1), a Leonides Major helicopter engine as installed in the Westland Whirlwind (Type 755/1), and a Leonides 530 series for fixed-wing aircraft (Type 531). All three engines were shown at Farnborough last year; but there will be one new engine at Paris—the 550-series Leonides helicopter engine, suitable for the Agusta Bell, Sycamore and Widgeon. This engine is undergoing tests at the moment of writing and it is hoped to announce performance figures before the Paris Show.

The Leonides Major uses the same size of cylinder as the Leonides, but has fourteen instead of nine. Overall diameter is only 38.925in. Maximum take-off rating of the 702/1 fixed-wing engine is 875 h.p. at sea level and maximum power rating 885 h.p.

The 531 fixed-wing single-row Leonides has a diameter of 43in and has a take-off rating of 615/640 h.p. at sea level. Maximum power rating is 650 h.p. This new series of Leonides has a capacity of 783 cu in (the earlier Leonides has 718.6 cu in) obtained by increasing the stroke to 4.8in. At the same time the internal power section of the crankcase has been strengthened. These changes have slightly increased the diameter from 41.5in to 43in.

Two of the new Leonides engines are the powerplant of the latest version of the Scottish Aviation Twin Pioneer (Series 3).

Alvis Ltd., Holyhead Road, Coventry.

Avica Equipment Ltd. (Stand No. 84B) This company lists its exhibits as follows: *Stainless-steel flexible pipe assemblies.* Fuel, oil and air supply lines for high temperatures and pressures. Many types of fittings available, including the Type "W" welded fitting for fireproof requirements. Resistant to most corrosive fluids or gases. *Stainless-steel bellows assemblies.* As expansion joints and to correct malalignment in all types of piping and ducting systems. *Swivel pipe couplings.* For high pressure systems—up to 4,000 lb/sq in hydraulic—where a low turning torque is required in operation. Permits movement of rigid tube systems, through 360 deg if required. Extensively used on the Britannia undercarriage.

Rigid tube couplings. These eliminate welding or brazing of flange or nipple connections on aluminium or stainless steel rigid tube assemblies. On sizes of ¼in O.D. tube up to 7in O.D. tube pressure tight joints can be made without the distortion associated with welded joints. *Support clamps.* Incorporating a replaceable cushion the material of which can be altered to meet varying temperature conditions, or resistance to different oils and fuels. *Flexible fuel-line coupling.* Designed to simplify installation problems on aircraft fuel systems, by avoiding special preparation of rigid tube ends. Absorbs axial and longitudinal movement during operation.

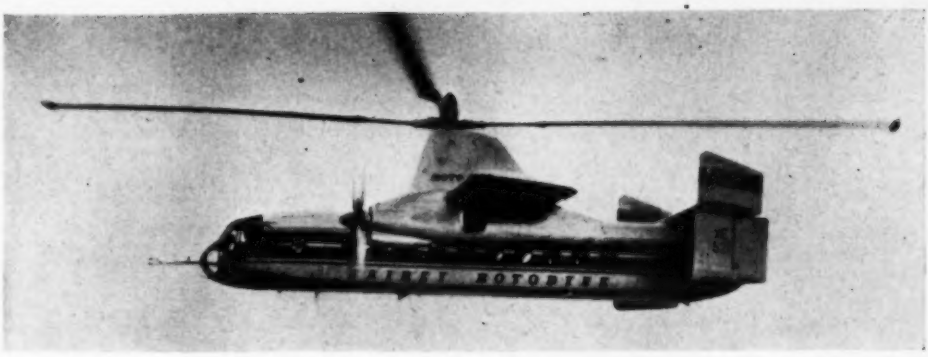
Avica ON MARK Quick Disconnect Couplings. These fittings are seal couplings designed for hand operated or remotely controlled quick disconnect of supply lines. Used extensively on guided weapon ground-support installations. *Synthetic rubber flexible assemblies.* For high-pressure and all aircraft fuel, oil and air systems. Fittings are available for on-site assembly to meet ground service requirements. *Electrical harness.* H.E. and L.T. ignition harness, thermocouple harness and starter lead assemblies.

Avica Equipment Ltd., Mark Rd., Hemel Hempstead, Hertfordshire.

Bell's Asbestos & Engineering Ltd. (Stand No. 111B) Bell's will be showing a general range of Bestobell products, including asbestos fire seals, synthetic rubber and asbestos mouldings, silicone rubber components for air-conditioning and de-icing systems, garter spring fire seals, etc. Among the new exhibits will be a silicone and terylene collapsible air starting hose, which is shown for the first time, and, in

Making its first appearance at an international air show will be Armstrong Whitworth's Argosy. Four are already flying and three are seen below

Britain's Contribution to the Paris Show...



The Fairey Rotodyne vertical take-off airliner is bound to create exceptional interest

addition, improved types of Flexitwist silicone rubber and glass fabric hot air hose which provides both flexing and twisting motion. In addition, a new stainless-steel wire-mesh fire seal is being exhibited.

Bell's Asbestos & Engineering Ltd., Bestobell Works, Slough, Bucks.

Blackburn Aircraft Ltd. (Stand No. 107H) The Blackburn NA.39 naval strike aircraft will be presented in the flying display, and its demonstration of manœuvrability at low and high speed will include a typical "toss-bomb" manœuvre.

This two-seat, low-level, strike aircraft is powered by two de Havilland Gyron Junior turbojets. Dimensions are: length, 62ft 4in; span, 42ft 6in; height, 16ft. A recent statement by the makers reads: "Boundary-layer control over the total span enables the NA.39 wing to attain the highest lift coefficient yet achieved on this class of wing. In the take-off and landing configurations the performance is well in advance of any comparable aircraft, the control being good down to the stall. Area rule minimizes the drag of the NA.39 because it allows the airflow gradually to contract and expand over the total cross-section of the aircraft. This has special virtues for high-speed, low-level flying as it ensures good control response and a smoother ride for the crew.

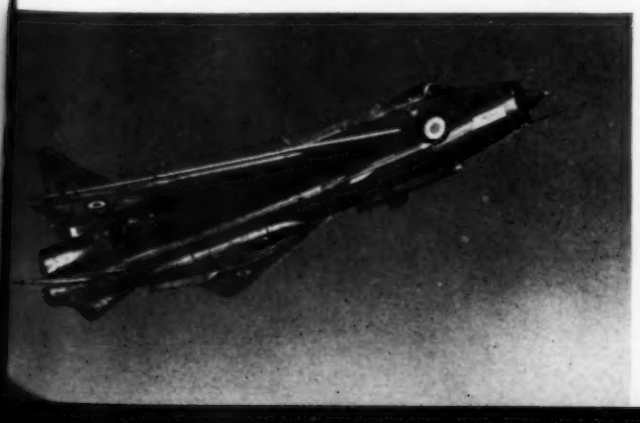
"For high-speed, low-level operations, great strength and stiffness combined with a long operating life are vital. Integral construction based on sculptural milling ensures the stiffness of the NA.39, and Blackburn engineers have built in the necessary long-life factor. . . ."

An N.A.39 will be in the static park at Le Bourget on June 19 and will be flying on June 20 and 21.

The following gas turbines will be exhibited: *Starter Truck:* A compact, self-propelled version of the low-pressure, air starting trolley. A Palouste air-bleed gas turbine is installed in the truck and 4,000 aircraft engine starts are possible between overhauls. Mounted on a 15 cwt Commer vehicle, this unit has not only started the NA.39 but has been in daily use with Pan American Boeing 707s at London Airport. *Starter Trolley:* Trolleys incorporating the Palouste air-bleed gas turbine have been supplied to the Royal Navy and the R.A.F. For carriage on aircraft a starter pod is available and this fits existing weapon pylons. *A.129:* This is a free-turbine, shaft-drive engine having an increased overall pressure ratio compared with the Turmo 600. A two-stage axial flow compressor is embodied in the gas generator, which also incorporates the standard combustion chamber and an axial-flow two-stage turbine. A third stage or free turbine, which is mechanically independent of the gas generator constitutes the power output turbine. This design is claimed to attain a high power/weight ratio with reduced fuel consumption and is the first of a new range of gas turbines in the 970 s.h.p. category. *Turmo 600:* The Turmo, a free-turbine, shaft drive unit, is installed in the Saunders-Roe P.531 helicopter. Since the power output turbine is mechanically independent of the gas generator, this engine possesses great flexibility and low-speed torque. In its standard form, the power turbine drives through a two-stage reduction gearbox at the rear of the engine. Two noteworthy applications are as a prime mover for rotary wing aircraft and as the power unit of a lightweight, emergency generating set. *A.A.P.U.:* Basically, the airborne auxiliary power unit is a gas turbine which will provide both shaft power and compressed air. It comprises a standard Palouste air-bleed engine with the rotating assembly shaft extended forward to an output gearbox.

Blackburn Aircraft Ltd., Brough, Yorks.

English Electric will be demonstrating the twin-Avon, Firestreak-armed Lightning intercepter, seen below with auxiliary tank



Bristol Aerojet (Stand No. 29H) There will be on this stand a selection of rocket-motor cases and high pressure storage vessels for use on guided missiles and aircraft. Bristol Aerojet is manufacturing many types of rocket-motor cases—ranging in length from 24in to 18ft, and in diameter from 6in to 18in. Among the exhibits is the motor case manufactured by the Company for the Raven solid-propellant rocket motor, power unit of the Skylark which was used on upper atmosphere research during the International Geophysical Year. The company has also developed a wide range of high-pressure gas-storage vessels—a number of which will be on exhibition—for use in guided missiles and aircraft. These vary in shape from the spherical to the cylindrical and annular.

Bristol Aerojet Ltd., Banwell, Weston-super-Mare, Somerset.

Bristol Aircraft Ltd. (Stand No. 14A) This company will be represented by transport aircraft, helicopters and guided weapons. Making its first public appearance will be a Britannia 253 of Royal Air Force Transport Command. This, together with the Bristol 192 turbine-powered helicopter, will be taking part in the flying display. In the guided weapons park the company will be exhibiting a Bloodhound guided missile together with ancillary equipment including launcher, limber, loading trolley and a launch control post. Missile handling demonstrations will be staged by a team of R.A.F. personnel. A stand in the exhibition hall will show 1/24th scale models of the Bristol 192, the Britannia 253 and a Britannia in the livery of Air Charter Ltd. Models of a Bloodhound launching site will be on display, and a continuous sound film will illustrate the capabilities of the missile in action against target aircraft.

Twenty Britannia 253s are being built for Transport Command and deliveries have already begun. The 253 is a long-range trooping aircraft, easily convertible for use as a freighter. A specially strengthened floor and large loading door permit the carriage of army vehicles and other items of bulky military equipment. Gross weight, 180,000 lb; max. payload, 34,450 lb; max. still-air range, 6,400 miles; mean cruising speed, 398 m.p.h.; powerplants, 4 Bristol Siddeley Proteus 765.

The Type 192 is primarily a military helicopter. It has been designed to meet Service requirements for troop and freight transport, search and rescue, ambulance, paratrooping and supply dropping duties. It is a twin-gas turbine engine helicopter with tandem rotors, a particular feature of which is the ability in an emergency to maintain cruising flight on one engine. Single-engine performance of the 192 will be demonstrated in the flying display. Up to 25 fully armed troops can be carried, or in the ambulance rôle the helicopter can accommodate 12 stretcher cases and two "sitting wounded." Gross weight, 18,000 lb; max. payload, 6,000 lb (2,722 kg); max. still-air range, 450 n.m. (835 km); mean cruising speed, 138 m.p.h.; powerplants, 2 Napier Gazelles.

The Bristol/Ferranti Bloodhound surface-to-air guided weapon system, already in service with the R.A.F., will assume a key rôle in the air defence of the United Kingdom. The system has also been ordered by the Royal Swedish Air Board for the defence of Sweden. Powered by two Bristol Siddeley Thor ramjet engines, Bloodhound is claimed to have a larger range than any semi-active homing missile in the Western world.

Bristol Aircraft Ltd., Filton House, Bristol.

Bristol Siddeley (Stand No. 6H) Bristol Siddeley exhibits will include the Olympus Mk 201, Sapphire Sa 7R, Orpheus Mk 803 and Viper ASV.11 turbojets; the Mk 765 Proteus and P.182 turboprops; the P.181 turboshaft engine for helicopters; the Thor BT-2 ramjet; the Gamma and PR-23 rocket motors; the gas turbine compressor unit; ball screws and splines.

Olympus engines of the Mk 200 series are in production for the Avro Vulcan B.2, and a developed version of the Olympus has been specified for the TSR.2, the new tactical support/reconnaissance aircraft for the R.A.F. The latest version of which details may be released, the Olympus Mk 201 (BOl.7), completed an official type test at a rating of 17,000 lb thrust in June 1958, and is believed to have the highest thrust/weight ratio of any type-tested high-thrust turbojet in the world today. With Bristol Siddeley Solar fully-variable reheat this engine has produced 24,000 lb of thrust.

The Sapphire Sa 7R is fitted with a limited reheat system which gives a 12½ per cent increase in thrust; it is fitted to the Javelin FAW.8 This engine, a Series 200, has been developed to produce 11,000 lb thrust dry and 12,230 lb thrust with limited reheat.

The Orpheus 803 turbojet is the powerplant for the Fiat G.91, which has been chosen as the standard lightweight strike fighter for NATO

Above, Blackburn NA.39. Below, Hawker Hunter Two-Seater

Britain's Contribution to the Paris Show . . .

forces. The current 803 version has a type-tested rating of 5,000 lb for a weight of only 835 lb, giving a thrust/weight ratio of 5.99 : 1—the highest yet for any type-tested engine.

An even more advanced version of the engine, the Orpheus BOr12, of 6,810 lb thrust, which can be boosted to 8,179 lb by the use of simplified reheat, is now being developed.

Having successfully completed its type test at 2,500 lb thrust for a weight of only 500 lb the Viper 11 represents the latest stage in the development of this turbojet. This unit is the result of thousands of hours of successful flying with the ASV.5 and ASV.8 fitted to the Hunting Jet Provost. It also powers the second prototype Macchi 326 trainer, and is in production for this aircraft.

The Proteus 762 is an intermediate rating, developing 4,350 e.h.p. for take-off, but with the same cruising power as the Series 761, enabling greater payloads to be lifted out of tropical airfields. The most powerful of the 760 series, the 765, is now being fitted to all Britannias being built to meet existing orders and develops 4,445 e.h.p. for take-off.

In December last Bristol Siddeley announced that a still more powerful version of the Proteus, the 770, was under active development. This engine offers a take-off power of 4,615 e.h.p.

The P.181 and P.182 have been designed to meet the present need for engines of approximately 1,000 s.h.p. Both are based on the same basic gas generator unit, but the P.181 is tailored to satisfy the special requirements of rotorcraft and STOL-type applications, whilst the P.182 is a turboprop engine for fixed-wing aircraft. Independent power turbines are features of both engines, which differ mainly in the method of drive.

The makers state that from the beginning considerable emphasis has been placed on producing robust engines that will give the utmost reliability and have long overhaul lives.

Development of both the P.181 and P.182 is being undertaken on high priority. The P.181 commenced test bed running on September 1, 1958, and is due to fly in a helicopter in the very near future.

The Thor ramjet powers the Bristol Ferranti Bloodhound surface-to-air guided missile. Each of the two units fitted, although easily carried by two men, is capable of developing the equivalent of some 100,000 h.p. at sea level at Mach 3. Moreover, the makers claim, at this speed its specific fuel consumption will be lower than that of any other known kind of engine.

The Bristol Siddeley Rocket Division has been designing and developing rocket engines since 1946, and has the distinction of having developed the first British liquid fuel rocket engine. The Gamma Mark 201 liquid-fuel rocket is of multi-chamber configuration and unlike previous designs, runs on a mixture of HTP and kerosine. An unusual feature of the Gamma is that each of its four combustion chambers is gimbal mounted and can swivel under hydraulic actuator control to provide vehicle guidance. The Gamma produces a total sea level thrust of 16.400 lb and this figure rises to nearly 19,000 lb outside the earth's atmosphere.

The PR23 rocket unit weighs only 32 lb and produces a thrust of 500 lb at sea level, burning kerosine and high-test peroxide. The thrust can be smoothly controlled down to at least a third of the maximum with only a slight reduction in specific impulse.

The gas turbine compressor (GTC series) unit is a typical example of the range of auxiliary power units now manufactured by Bristol Siddeley Engines Limited, under licence agreement with the AiResearch Manufacturing Company of U.S.A.

Similar to the above, but providing shaft power as well as compressed air, are the range of gas turbine compressor and power units (GTCP series) which will deliver either shaft power up to 400 s.h.p., compressed air at 2 lb/sec, 35 lb/sq in and 190 deg C or a combination of both, at up to 50,000ft. The GTCP unit has therefore the additional advantage of supplying adequate shaft power for driving electrical generators, alternators and hydraulic pumps, etc. Where shaft power only is required, a further basic type of auxiliary power unit is available. This is the GTP series, ranging from the GTP.30—a unit of 40 lb with an output of 30 s.h.p.—to the GTP.250, of 170 s.h.p., for powering military and industrial-type equipment such as generators in the 100 kW class.

Bristol Siddeley Engines, Ltd., P.O. Box 3, Filton, Bristol.

The British Thomson-Houston Co. Ltd. (Stand 60A) The main exhibit by BTH, as part of the Scintex stand display, consists of a diagrammatic layout showing the principal components of the variable-speed A.C./D.C. power system, similar to that on the Comet 4.

One power channel is shown, which is capable of delivering 350 A at 28V D.C. over a generator speed range of 3/1. Individual components are in section, or with Perspex covers or bases, in order to show details of construction.

Also on show will be a selection from the range of BTH aircraft equipment, including high-energy ignition units, aircraft switches, motors, etc.

The British Thomson-Houston Co. Ltd., Rugby.

Canadair Ltd. (Stand No. 103H) In co-operation with D. Napier and Son Ltd., Canadair will be giving demonstration flights with the Napier/Convair 540. A note on characteristics appears under "Napier." On their own stand Canadair will show a model of this aircraft, together with models of the CL-44D long-range, Tyne-powered freighter, CL-28 Argus long-range maritime-reconnaissance aircraft, and CL-41 jet trainer.

Particular interest is likely to be aroused by the model of the CL-44D, which in its -4 version, with swing tail, has been ordered by Seaboard and Western Airlines and the Flying Tiger Line to the extent of $70 million. The swing-tail permits loading and unloading of 32½ tons of cargo in 19 minutes. The fuselage will accommodate a single unit weighing up to 65,000 lb and measuring about 85ft in length, 11ft in width and 6¼ in height. Maximum cruising speed is over 400 m.p.h.

Canadair Ltd., Montreal, Quebec, Canada (European representative: J. H. Davis, Princes House, 190 Piccadilly, London, W.1).

CIBA (A.R.L.) Ltd. (Stand No. 81A) The main theme of the CIBA (A.R.L.) stand is the use of Redux adhesives and Aeroweb metal honeycomb in modern aircraft. On display will be applications in the Vanguard, Comet 4, Argosy, F-27 Friendship and the Alouette.

Redux bonding has now been employed in more than 70 different types of aircraft, and it is being put to increasing use in a number of aircraft now under construction.

Aeroweb honeycomb core is used extensively in the aircraft and missile industries for structures subject to low or medium loading intensities, and applications in wings, control surfaces, floor panels and many other components have proven, it is claimed, the exceptional strength, stiffness and surface smoothness of this form of construction. Its very high resistance to jet noise damage is an increasingly important factor in modern aircraft.

Information on these products, as well as on the latest Hidux high-temperature adhesives will be available.

CIBA (A.R.L.) Ltd., Duxford, Cambridge.

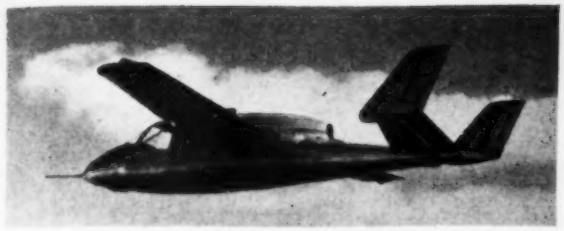
Cossor Radar and Electronics Ltd. (Stand No. 107B) Principal Cossor exhibits are detailed below:—

Cossor Airborne Secondary Radar System Type 2A. For several years Cossor have been concerned with the development of a system of air traffic control using secondary radar. They provided ground and airborne equipment for the official evaluations in the U.K. and the U.S.A., which preceded its adoption as a system by I.C.A.O.

In a secondary surveillance radar system a ground interrogator transmits a suitably coded sequence of pulses on one frequency. These pulses are received by an airborne receiver and, if the coding is appropriate, the output from this receiver causes an airborne transmitter to radiate a differently coded sequence of pulses on a different frequency. In this case the coding system permits the transmission of information concerning the aircraft's identity, height, etc. A total of 64 codes is currently available.

The sequence of pulses is received by the ground equipment and can be decoded and the coded information, together with the aircraft's range and bearing, which can be measured by secondary radar in the same way as in primary radar, can be displayed in various suitable ways. A feature of the system is the "side-lobe suppression" technique, whereby responses from the aircraft caused by interrogations other than by the

Scottish Aviation Twin Pioneer



Above, Miles Student (top) and Edgar Percival Prospector. Right, Westland Westminster

main directional lobe of the ground aerial are prevented from occurring.

The transponder SSR.1251 is designed to I.C.A.O. recommendations. It is suitable for operation to an altitude of 20,000ft and automatically provides an air traffic controller with the position and flight information of the aircraft in which it is installed up to a range of 250 n.m.

SSR.1251 is a self-contained transponder meeting the requirements of ARINC 404 for the ½ A.T.R. long dimensions including extractor plate, rear plug and indexing pin arrangement.

Cossor Radar and Electronics Ltd., Cossor House, Highbury Grove, London, N.5.

C.T. (London) Ltd. (Stand No. 107B) On Stands 105B, 107B and 109B this company will show, as agents, products of Sir George Godfrey and Partners Ltd., Murphy Radio Ltd. (Electronics Division), Cossor Radar and Electronics Ltd., Mechanism Ltd., and W. Vinten Ltd., for details of which see under the respective companies.

C.T. (London) Ltd., 27 Ashley Place, London, S.W.1.

de Havilland Propellers Ltd. (Stand No. 69H) D.H. Propellers will be showing a Firestreak infra-red homing guided missile and an 11ft propeller for the Gnome turboprop.

The Firestreak forms the standard main armament of the Lightning, Javelin and Sea Vixen aircraft in service with the R.A.F. and the Royal Navy. Components are grouped in six main sections—the guidance, control and fusing systems, power supply, propulsion motor and warhead; all are housed within an aerodynamic body tube measuring 10ft 6in in length and fitted with four small wings and four control fins. The infra-red homing system employs a detector eye which is sensitive to the infra-red rays emitted by the target. Once it has locked on to the target the eye feeds information into the control system to ensure that the weapon will intercept the target no matter what manœuvre it may perform. The Firestreaks may be fired singly or in pairs at subsonic or supersonic speeds, and provision is made for jettisoning in an emergency. Ancillary equipment required in a parent aircraft has been designed and developed by de Havilland Propellers Ltd. in parallel with the main Firestreak project.

In recent trials by the Royal Navy, using Sea Venom aircraft, 80 per cent kills were recorded.

The propeller for the Gnome is claimed to meet all the latest requirements for modern turbine engines and contains a number of new operating and safety features.

de Havilland Propellers Ltd., Hatfield, Herts.

The de Havilland Engine Co. Ltd. (Stand No. 69H) On this stand there will be a Gyron Junior DGJ.1 turbojet, a Gnome P.1000 turboprop, and a Gnome helicopter engine. The Gyron Junior DGJ.1 has a static thrust of 7,000 lb. Units of this general type power the Blackburn NA.39 and incorporate in their design provision for air bleed for aerodynamic-lift purposes. The Gnome P.1000 delivers 1,000 s.h.p. in its initial version and weighs only 555 lb dry. The more powerful P.1200 version is specified for the new Bréguet 941 military or civil STOL transport. The Gnome helicopter engine (1,000 s.h.p.) has a basic weight of only 275 lb. The unit displayed will be a standard production engine, scheduled for installation in a Westland Whirlwind. Gnome engines are also specified for the new Agusta 101G helicopter and for an advanced version of the Saunders-Roe P.531.

Particular interest will, of course, attach to the new P.1000 turboprop, which is a propeller-driving version of the Gnome H.1000 (DGe.1) turboshaft unit. The engine is of free-turbine type and comprises an axial compressor, an annular combustion system, a high-pressure turbine driving the compressor, and a mechanically free low-pressure turbine providing the high-speed output drive. The compressor and high-pressure turbine constitute the gas generator portion of the engine. High-speed reduction gearing, mounted adjacent to the exhaust duct, transmits the power turbine drive to an offset shaft mounted parallel with the engine. This in turn drives into low-speed gearing at the front of the engine, providing the final reduction to the propeller. The casing for the offset shaft, together with the two gearboxes, constitutes the structural backbone to which the engine is attached.

The de Havilland Engine Co., Ltd., Leavesden, Herts.

Delaney Gallay Ltd. (Stand No. 127A) Delaney Gallay will be exhibiting examples of all their products, including primary and secondary surface oil-coolers, anti-icing heat exchangers, thermal insulation blankets and ducting, stainless steel toilet units and examples of flux-bath brazing and stainless-steel fabrication. They will also be showing their new "Incorporall" portable welding kit for mild and stainless steels, a new welder for stainless steel that can operate when only one side of the job is accessible, and a new universal welder that, with different attachments, is equally suitable for spot, seam or protection welding.

Delaney Gallay Ltd., Vulcan Works, Edgware Road, London, N.W.2.

The Dowty Group (Stand No. 45A) The Dowty Group are exhibiting a wider variety of exhibits than on any previous occasion. This advance is partly the result of Rotol becoming a member of the Group. The Dowty Group now claims to be the largest manufacturer of aircraft components in Britain.

The following companies of the Group are contributing to the Dowty stand: Dowty Equipment Ltd.; Dowty Fuel Systems Ltd.; Dowty Nucleonics Ltd.; Rotol Ltd.; Dowty Seals Ltd. Overseas service for all the Group companies except Rotol is provided by Dowty Exports Ltd., who will also be represented. Overseas service for Rotol customers in North America is provided by Rotol Incorporated, Arlington, U.S.A.

Dowty equipment is fitted to two important French aircraft, the Dassault Mystère, for which electrical and hydraulic units totalling in value almost half-a-million pounds have been supplied, and the Sud Caravelle, which is equipped with Dowty magnetic indicators. Rotol propeller equipment, made in France by Louis Bréguet, is used on the Nord Noratlas and the Bréguet Alizé.

Two important units have now been added to the Dowty range, and will be exhibited. These are the Dowty Moog valve and the Rotol hydro-mechanical constant-speed drive. The Moog valve is an electro-hydraulic servo valve for control systems requiring electrical signalling to be converted into proportionate hydraulic movement of substantial force.

The following list of exhibits to be shown indicates the variety of aircraft components now manufactured by the Group: Undercarriages and nose wheels for Argosy, Friendship and Gnat, and for a modern supersonic intercepter fighter. Hydraulic equipment for aircraft and missiles, including the new range of Dowty Moog servo-valves, Vardel and Super Vardel hydraulic pumps, and hydraulic motors. Typical propeller and propeller brake for gas turbine engines; propeller operating cylinder with pitch-lock mechanism; propeller controller unit, and feathering pumps. Ram-air turbine for providing emergency power supply for essential flying controls and the 15 kVA turbo-alternator for supplying current for electrical services. Fuel systems for gas turbine engines, notably the Gyron Junior. (Units include fuel pumps, spill nozzles and complete spill system.) Gearbox—one of four installed on the Vanguard to provide mounting faces for the various aircraft accessories, which are driven through gears and quills, the necessary engine power being transmitted by the gearbox drive. 40 kVA hydro-mechanical constant-speed drive. Two-cell fuel-flow proportioner, incorporating a hydraulic motor, enabling it to function as a line-booster pump as well as a flow proportioner. A wide range of electrical equipment including Hermio, Dowmio, and Greasfil switches; two- and three-position magnetic indicators; press-to-test indicators; undercarriage-position indicators; lever switches; single- and multi-push button switches; solenoids; drum switches; and commutator switches. Examples of Dowty sealing components in natural, synthetic and silicone rubbers, including standard- and special-section seals, bonded seals, and moulded-rubber components.

The Dowty Group Ltd., Cheltenham, Glos.

Vickers-Armstrongs Vanguard

Britain's Contribution to the Paris Show . . .

Dunlop Rubber Co. Ltd., Aviation Division (Stand No. 115H) Dunlop will be showing tyres, wheels, brakes, Maxaret anti-skid units, de-icing equipment and windscreen wipers, with particular emphasis on Dunlop equipment for the Sud Caravelle airliner. Also on show will be 3,000 lb/sq in compressors and pneumatic actuating valves, rams and selectors.

The Maxaret anti-skid unit has been designed to provide the most efficient braking torque throughout the landing run, but to eliminate the danger of skidding. The unit consists of a valve arrangement regulated by a flywheel housed in a rubber tyred shell that is rotated by direct contact with the rim of the main landing wheel. Excessive deceleration displaces the flywheel in relation to the shell and operates the valve mechanism. This releases the pressure in the brakes and closes the pressure supply until the wheels regain forward movement. The balance of flywheel and drum is then restored and pressure is again admitted to the brakes until signs of an approaching skid repeats the cycle of operation. The main advantages of the use of the Maxaret anti-skid unit are claimed as: (1) maximum braking with full pilot control is available under all conditions. This ensures the shortest possible landing run; (2) improved tyre life and performance, as the severe local wear due to even slight skids is prevented.

Dunlop Rubber Co. Ltd., Aviation Division, Holbrook Lane, Foleshill, Coventry.

Edgar Percival Ltd. The aircraft formerly known as the E.P.9 has now been renamed the Prospector, and as such will be demonstrated at Paris. The Prospector will give a spraying demonstration on several days of the show and will also be exhibited as a freighter and fitted with stretchers for ambulance work. Powered with a Lycoming GO-480 engine the aircraft can seat pilot and five passengers. Economical cruising speed (passenger version), 120 m.p.h.

Edgar Percival Aircraft Ltd., Squires Gate Airport, Lytham St. Annes, Lancashire.

E.M.O. Instrumentation Ltd. (Stand No. 18A) On this stand will be a torque-testing machine, for measuring accurately the starting and running torques of precision bearings, and complete synchros. Also on view will be a bearing washing unit—for washing precision bearings and ensuring absolute cleanliness. Additionally there will be a display of precision bearings to ABEC 5 and 7 specifications and to British Government and American specifications. These bearings are used by leading manufacturers of gyro flight instruments, computers, cold-air units, synchros, servo motors, etc.

E.M.O. Instrumentation Ltd., Western Road, Bracknell, Berks.

English Electric Aviation Ltd. (Stand No. 20H) The English Electric Lightning intercepter fighter, as now in quantity production for the R.A.F., will fly over to Le Bourget on June 19 and will be demonstrated in the flying display on the following two days. It will not appear in the public park. The Lightning is powered with two Rolls-Royce Avon turbojets with reheat and has Mach 2 performance. Primary armament is two de Havilland Propellers Firestreak missiles. A side-by-side two-seater development, the P.11, is already flying.

English Electric will also be showing a Thunderbird Mk 1 ground-to-air missile on its mobile launcher, and possibly operated by an Army team. The Thunderbird Mk 1 has a cruciform of fixed wings and a rear cruciform of control fins. The light-alloy body has an ogival nose of dielectric material and a boat-type tail. Thunderbird test vehicles were fitted with liquid-propellant sustainers, but the production missile has a high specific impulse and probably gives a range at least as good as that originally obtained with the liquid motor. Four wrap-around boost motors are used to provide the acceleration needed for zero-length launching at a high angle of elevation.

On Stand 20H there will be a range of products by English Electric's Aircraft Equipment Division, including constant-speed drives and other items of A.C. equipment as supplied for the Mk 2 versions of the Vulcan and Victor bombers. The instrument wing of the company's Guided Weapons Division will be represented by stabilized platforms and MIG gyroscopes made under licence from Minneapolis-Honeywell. Also on the stand will be models illustrating the operational deployment of the Thunderbird missile. Other models will show the Lightning and Canberra PR.9 high-altitude photographic-reconnaissance aircraft. The theme of another exhibit will be "ten years of Canberra achievement."

English Electric Aviation Ltd., Marconi House, Strand, London, W.C.2.

Fairey Aviation Ltd. (Stand No. 21H) Fairey will have a Rotodyne vertical take-off airliner in the flying display and a Jindivik Mk 2B target aircraft on static exhibition. Indoors there will be a one-eighth scale model of the Rotodyne showing specimen 65-passenger loads, cargoes and a typical military load. A guided weapon panel will illustrate the purpose of the Jindivik target and will mention Fairey's new anti-tank guided weapon for the British Army. A model of the Gannet AEW Mk 3 carrier-borne early-warning aircraft will be supplemented by a panel illustrating the rôle of this new type. Finally there will be a display of investment steel castings made by the company for different aircraft.

The Rotodyne is likely to prove one of the outstanding attractions of the show. It will be seen in prototype form, powered by two Napier Elands. The production version, ordered by New York Airways and by Okanagan Helicopters will be larger, faster and more powerful. It will be powered by two Rolls-Royce Tyne engines and will carry 57 passengers or 15,000 lb of freight at a speed of more than 200 m.p.h. over a 250-mile stage (i.e., London to Paris) with full allowances. Maximum passenger load will be 65 (or 18,000 lb of freight) over 120 miles; range will be 650 miles.

The two turbine powerplants of the Rotodyne are so arranged as to feed compressed fresh air to the main rotor for vertical flight; most of the power is absorbed at take-off by the rotor, the tip of each of which it fitted with a kerosine-burning pressure jet. Transition to forward flight is achieved by progressively transferring power from the rotor to the propellers. In this condition the Rotodyne cruises solely on the thrust of the propellers, lift being provided by the autorotating rotor and the conventional wing, the last-named component providing about 60 per cent of the lift during the cruise.

The production version of the Rotodyne will have a rotor diameter of 104ft and a gross weight of 50,000 lb.

Fairey Aviation Ltd., Hayes, Middx.

Folland Aircraft Ltd. (Stand No. 105A) Folland will be exhibiting the following items: A ¼-scale model of the Gnat Mk 1 interceptor and ground-attack fighter. A ¼-scale model of the Gnat two-seater transonic trainer, of which a pre-production batch of fourteen has been ordered for development for the Royal Air Force. Models of the Gnat Mk 1, showing the range of underwing weapons and stores which can be carried by this aircraft in the tactical rôle. A selection of Gnat Mk 1 components, chosen to illustrate simplicity, weight saving and other features characteristic of the Gnat and Gnat Trainer. Application of the Folland combined parachute and seat harness to aircraft ejection seats.

Folland Aircraft Ltd., Hamble, Hants.

Garringtons Ltd. (Stand No. 143H) Garringtons name their primary exhibits as compressor and turbine blades forged to over-size, close or precision limits in alloys of aluminium-bronze, steel, nickel, titanium and nimonic in prototype or bulk quantities. They also list the following: *Flap-selection unit:* This item has been invented and patented by B.O.A.C. and will shortly be fitted to all their aircraft. *New type of universal joint:* This joint is especially adaptable for controls and systems of leverage where angular variations are encountered and where a possibility of danger to controls through corrosion can be encountered. *Gydelite reflecting stud:* The object of this stud is to mark taxying ways and perimeter tracks with the type of marker which will react to the running of taxying lights of any size of aircraft. This will enable the use of studs in place of electric lighting.

Garringtons Ltd., P.O. Box No. 4, Bromsgrove, Worcs.

Sir George Godfrey & Partners Ltd. (Stand No. 105B) Among the principal exhibits on Stand 105B will be a cabin compressor Type 175 Mk 1 for the Vanguard; a cold-air unit CT-6 Mk 1 (a typical turbo-compressor cold-air unit for military applications), a cabin supercharger Type 15 (shown sectioned and supplied for the Viscount, Friendship, Herald, Argosy, Gulfstream, etc.), and a cold-air unit BT-7 Mk 1, as delivered to the R.A.F. There will also be a refrigerant compressor

Canadair Napier/Convair 540

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ACM8/200, which comprises an electric motor driving a Godfrey/SRM pump, the whole assembly being hermetically sealed. This unit is in production for cooling airborne equipment.

Other cold-air units will be the Type BT-7 Mk 2 (special lightweight version for the Gnat Trainer); TF-10 Mk 4 (fitted in all marks of the Britannia); and TF-5 Mk 1 (fitted in Canberras of the Royal Australian Air Force). Other items on show will be the flow-control valve CV-20 Mk 2 for use in air-ventilated suit systems; water extractor WE-15 Mk 1, produced in quantity for several fighter aircraft; water extractor Type WE-100, fitted in certain Viscounts and in the Argosy; and the shut-off valve BV-2, which is claimed to have an extremely low leakage rate.

Sir George Godfrey & Partners Ltd., Hampton Road West, Hanworth, Middx.

Handley Page Ltd. This company had hoped to demonstrate a Dart Herald multi-purpose transport, but the aircraft is now expected to be demonstrating in South America at the time of the Paris show.

Handley Page Ltd., Claremont Road, Cricklewood, London, N.W.

Harley Aircraft Landing Lamps (Stand No. 38B) The largest Harley exhibit will be the Model "T" mobile floodlight—a self-contained, self-propelled searchlight unit which can be brought into operation in a matter of seconds. Harley landing lamps for fixed-wing aircraft and helicopters on show will be: Model 11 Mk 9 electrically retractable (750/240W); Model 9 Mk 9 electrically retractable; Model 9 Mk 12 electrically retractable (500/240W); Model 8 ND electrically retractable (280/280W); Model 6 Mk 2 electrically retractable (280/280W); Model 5 Mk 2 electrically retractable (280/280W); Model 11 Mk 7 leading-edge (750/240W); Mk 7 FD leading-edge (500/240W); Model 6 FD leading edge (280/280W); Model 7 HD nosewheel landing and taxi lamp (500/240W); Model 6 VS taxying lamp (144W); Model 11 Mk 10 electrically operated universal landing and searching lamp (750W).

Harley Aircraft Landing Lamps, Paxton Hill, St. Neots, Huntingdonshire.

Hawker Siddeley Group (Stand No. 25H) The Armstrong Whitworth Argosy will be publicly shown at Le Bourget for the first time. This "freightercoach," which marks the Group's re-entry into civil aviation, has been ordered by Riddle Airlines and its military version, the AW.660, has been adopted for R.A.F. Transport Command. With the Argosy will be demonstrated two types of advanced cargo handling systems (the A.W.A. pallet and roller conveyor system and the cargon system). In the Exhibition Hall a one-twenty-fourth scale model will be shown in a model servicing dock. The military version will also be displayed as a model with jeeps, guns and paratroops to scale.

The Argosy is powered with four Rolls-Royce Dart 526 turboprops and has a pressurized fuselage. Of twin-boom layout, it has a span of 115ft, a length of 86ft 9in, and carries a maximum payload of 28,000 lb. Indicative of the Argosy's efficiency is the following quotation from *Flight's* announcement of the Riddle order earlier this year: "In terms of productivity one Argosy should do the work of three or four C-46s; thus, four Argosies can be expected to take over the work of sixteen C46s—the number actually allocated to Riddle's scheduled routes."

Another exhibit will be the Group's latest project, the Avro 748 short/medium-range turboprop airliner. This will be shown as a one-twelfth scale model, complete with furnishings. Large display panels will illustrate the chief features of the aircraft—low operating costs, simplicity of servicing, fail-safe structure, ease of freight loading, etc. The Avro 748 is expected to fly early in 1960. A third exhibit will be a one-twelfth scale model of the Avro Vulcan B.2 with its Avro nuclear stand-off bomb; and a fourth will be a miniature Shackleton MR.3.

Avro will also show their strain gauges—extensively used by the Boeing company—and their limited-angle tachometer.

Representing Hawker Aircraft Ltd. will be a Hunter Two-Seater complete with stores. This aircraft will take part in the flying display during the later part of the Show. Stores displayed will include four 25 lb practice bombs together with carriers; gun belts; various rockets including Fireflash missiles; interchangeable gun pack for single-seat version; large and small auxiliary fuel tanks; bombs of various sizes; and napalm containers. Additionally there will be a Hunter Two-Seater demonstration front fuselage, which is readily interchangeable with that of the single-seater. A display board will show the world with models indicating where the Hunter has been sold.

Armstrong Whitworth's showing will not be limited to the Argosy. They will have a one-quarter scale model of a Seaslug ship-to-air missile, shown together with a sectioned IPN gas generator and turbo-alternator. The gas generator is an A.W.A. product developed specially for missile work. Shown full-scale will be a Seaslug in a ship-type double-barrel launcher. This display is being put on in collaboration with the Sperry Gyroscope Co. Ltd. and the General Electric Co. Ltd., who are the other two principal contractors on Seaslug. Sperry and G.E.C. will be showing various Seaslug components in prefabricated booths behind the launcher and there will be a colour film on Seaslug in action (commentaries alternately in English and French). Other A.W.A. exhibits will be a telemetry switch display, sweep oscillator, transistor galvonometer amplifier and a five-channel display unit.

The Gloster Aircraft Co. Ltd. will show a one-twelfth scale model of a Javelin Mk 9 complete with four Firestreak missiles. Other Gloster items will be an electro hydraulic servo valve, true-mass flowmeter (as supplied for the Vickers Vanguard), flight deck temperature control system (also for Vanguard), 100 series flowmeter, hot gas valve, pressure reducing valve, fuel proportioning valve (supplied to SNECMA for their Coleopter), velocity pick-up amplifier and force-rod.

Hawker Siddeley Group Ltd., 18 St. James's Square, London, S.W.1.

H.D. & M. (Aviation) Ltd. The Miles M.100 Student basic jet trainer will be exhibited in the static exhibition and in flight under the name of this company. There will also be, on the Hurel Dubois stand, components such as electric computer racks and servo assemblies, from flight simulators manufactured by Miles Electronics Ltd. A simple jet engine simulator will also be seen in operation. It is probable that there will also be one or two plastic components, manufactured by Miles Structural Plastics Ltd.

The Student has a metal, slightly swept wing mounted at shoulder level behind the side-by-side two-seat cockpit, engine air being drawn through a flush intake over the cockpit roof. Twin fins and rudders are mounted at the extremities of the tailplane. The nosewheel undercarriage retracts into the fuselage. Large, car-type floor-level doors in either flank of the cabin may be jettisoned to allow easy escape in an emergency.

Span is 29ft 2in, gross weight about 4,000 lb and maximum speed 302 m.p.h.

H.D. & M. (Aviation) Ltd., Shoreham Airport, Sussex.

High Duty Alloys Ltd. (Stand No. 105bH) For the first time this company is taking abroad samples illustrative of the special techniques used in the production of components and materials at its production divisions, together with a number of components being produced for Continental aircraft manufacturers. Among the latter will be four large forgings used on the undercarriage for the Caravelle.

Components illustrating the special techniques used in forging will include a cam-plate housing manufactured for Joseph Lucas (Gas Turbine Equipment) Ltd. This component was originally produced as a casting but is now manufactured as a re-entry forging. By using this technique, it is possible to produce form on all six sides of a cube. Another technique developed by High Duty's forging division is the production of components to a definite weight tolerance on totally enclosed dies. The component illustrating this is produced for Rotol Ltd. and is part of a synchronizer valve assembly. Draftless forging will be illustrated by an air impeller which is produced to extremely close tolerances for the Simms Motor & Electronics Corporation Ltd.

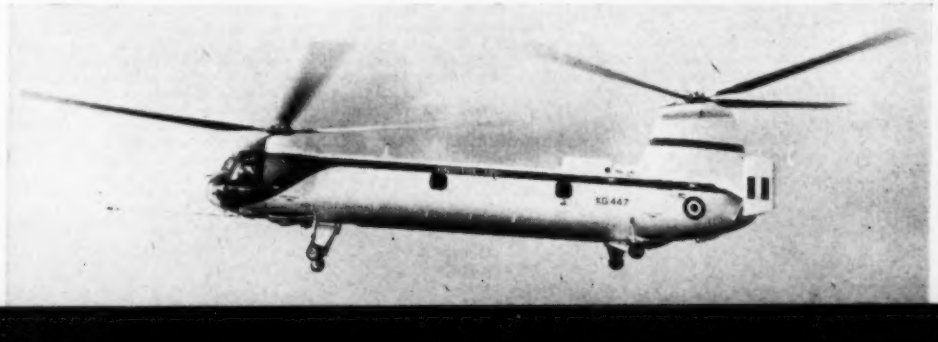
In precision forging, there will be examples both in Hiduminium and various types of steel. A component in Hiduminium will be a canopy for a fighter. This goes into service as produced from the dies, and the only machining which takes place is for the fixing holes. Precision-forged turbine and compressor blades in Hiduminium, stainless steel, Nimonic and titanium alloys will also be displayed. The Hiduminium sheet exhibits will consist of components produced from specially processed sheet. They will draw attention to the fact that quite a number of operations can be saved in production by having sheet produced for a particular operation. In addition, there will be examples of castings and extruded sections.

High Duty Alloys Ltd., Slough, Bucks.

H. M. Hobson Ltd. (Stand No. 89H) The list of Hobson exhibits is as follows: Type 333 fuel flow proportioner; feel simulator units (control Type 151 and jack Type 152) for the Britannia; flap control unit Type 338 Mk 1 for the Argosy; camber flap control Type 180 Mk 1 for the Caravelle; float chamber carburetter Type A.I.55-J for the French Potez 6D-00 engine; feel simulator units control Type 159 and jack Type 296 for the Caravelle; power flying control Type 145 for the Gnat; master-control injection carburetter Type A.L.16 for the Leonides (incorporating fuel control unit Mk 153/1, boost control unit Mk 58 and throttle housing Mk 3); constant-speed alternator drive Type 368; AL.M.6 injection carburetter and fuel pump (carburetter Type 122 and pump Type 123); Integral hydraulic pump Type 180; Integral hydraulic pump Type 181 Mk 4; Integral hydraulic motor Type 197; Integral hydraulic motor-pump unit Type 215; Integral electric motor-pump unit Type 213 Mk 1; Integral hydraulic motor Type 199; Integral electric motor-pump unit Type 216; and Integral hydraulic power-pack Type 275.

Particular interest will no doubt be shown in the feel simulator units for the Caravelle. These units apply artificial feel to the pilot's elevator and rudder controls. The feel simulator control modifies a hydraulic pressure according to the forward speed of the aircraft, and this modified pressure is transmitted to the feel simulator jacks which apply a centring force to the respective pilot's controls.

H. M. Hobson Ltd., Fordhouses, Wolverhampton, Staffs.



Bristol Type 192

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Lodge Plugs Ltd. (Stand No. 119bA) Lodge will be exhibiting their full range of aviation sparking plugs and high-energy igniters, which have been developed to meet the exacting requirements of the latest piston and jet engines. Perhaps their most important exhibit will be the Sintox ceramic insulator, which is a material of exceptional mechanical thermal and electrical properties. Apart from its use in plugs and igniters, Sintox has numerous industrial applications, some of which will be shown.

Lodge aircraft-plug servicing equipment will include a spark-and-leak tester and chemical-cleaning machine. This last overcomes the many disadvantages of the sandblast system.

Lodge Plugs Ltd., Rugby.

Joseph Lucas (Gas Turbine Equipment) Ltd. (Stand No. 99A) A comprehensive display of fuel system and combustion equipment for aircraft gas turbines will include sectioned and complete units comprising typical fuel systems for such power units as the Dart, Avon, and Conway and Orpheus.

Particularly interesting is a quick-release coupling for use in aircraft hydraulic, fuel and oil systems, which may be readily connected or disconnected simply by a one-hand movement without tools of any kind. In fact uncoupling may be effected easily even if the pipes are under the full pressure of their fluid content without danger of fluid leakage, yet the couplings remain locked at hydraulic pressures in excess of 12,000 lb/sq in.

There will also be a range of sealing rings. Wide experience gained in hydraulics as applied to fuel systems and the high pressures encountered has necessitated the manufacture of moulds to enable these rings to be made to the very fine limits required.

Typical of the range of pumps and motors now available for aircraft hydraulic systems is the type HOD pump to be displayed. Developed from the basic design of fuel pump used in gas turbine fuel systems for the past 20 years, this unit gives a useful flow up to 20 gal per minute at fluid temperatures between −55 deg C and +90 deg C at pressures of 3,000 lb/sq in and a speed of 3,000 r.p.m.

The range of fuel pumps displayed will include the Dart unit with a rated output of 438 gal/hr at a rated pressure of 2,000 lb/sq in and speed of 4,000 r.p.m. The Orpheus pump has a rated output of 1,300 gal/hr at pressure of 2,000 lb/sq in and speed of 3,000 r.p.m.; while that for the Avon and Conway has double the rated output (2,600 gal/hr) at a similar speed and pressure.

Main engine controls will include simple flow control (Dart); barometric pressure control (combined with idling by-pass, flow-distributor, dump-valve, non-return valve, and throttle valve) for the Orpheus; and range temperature control (Avon and Conway).

Amongst the items displayed by the combustion equipment factories of the organization are typical combustion chambers and flame tubes (sectioned or complete), an aircraft heater, heat-exchanger and a selection of structures fabricated from sheet metal.

Joseph Lucas (Gas Turbine Equipment) Ltd., Birmingham and Burnley.

Marconi's Wireless Telegraph Co. Ltd. (Stand No. 20A) Marconi are again exhibiting on the English Electric Group Stand. Their exhibits comprise four items from their range of aeronautical radio equipments, as under:—

Marconi Single-channel VHF Direction-finder Type AD210C. This provides, in a simple inexpensive form, the DF facilities normally required at a small airport. Operation is in the frequency range 100-156 Mc/s; any one of five crystal-controlled frequencies are available at the main display by push-button selection. The presentation of bearings is entirely automatic on a 20.3 cm-diameter bearing indicator. The display units are small, being suitable either for desk mounting or for incorporation in the airport's main control desk. A slave display may be operated in addition to the main display and can be situated up to 152 m from it. A simple remote system, operating over standard telephone lines permits remote operation up to a distance of 12.8 km.

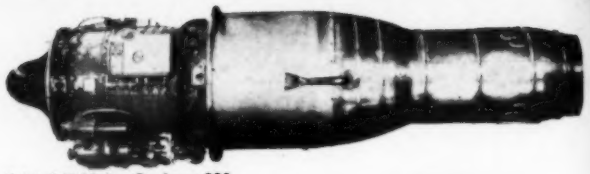
Automatic Direction-finder (Radio Compass) Type AD712. This is the only crystal-controlled automatic direction finder in the world and one which is rapidly gaining favour as representing a significant forward step in design. It is now flying as dual installations in all Comet 4s, and Hunting Clan's Britannias. In the near future it will also be flying in many other aircraft, including the Viscount, the Vanguard, the Argosy and Boeing 707.

One unique feature is that conventional tuning methods have been abandoned in favour of a completely new crystal-controlled system. This gives a simple switch selection of frequencies in the bands 100 kc/s to 415 kc/s and 490 kc/s to 1799.5 kc/s in steps of 0.5 kc/s. The control is locked to within ±50 c/s of the indicated frequency under all normal working conditions.

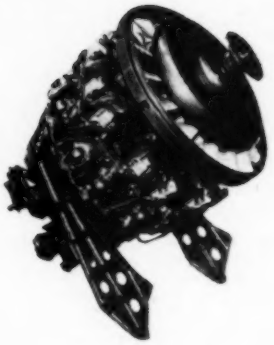
The direction finder employs a fixed crossed-loop aerial system with no moving parts. It is moulded in foamed resin, in a low-drag fibreglass casing only 3 cm high. It can thus be mounted externally even on high-speed aircraft.

Sub-miniature Automatic Direction-finder Type AD722. This equipment, which was originally developed especially for use in aircraft of the R.A.F., is now available to commercial operators. It has a growing popularity for use in helicopters. The Type AD722, which is primarily intended for pilot operation is considerably smaller than conventional types of radio compass (its total weight is 10 kg). Nevertheless, it is claimed to meet all the major requirements of this type of instrument and is not merely a "homer."

Transistorized Airborne Teleprinter Receiver Type AD308. This equipment has been designed and manufactured as a contribution to the problem of severe congestion which exists on the H.F. radio communications channels on busy air routes. One means by which the situation can be relieved is for non-urgent messages (such as meteorological reports) to be radiated from a ground station operating in the low-frequency band and received on a radio-teleprinter in the aircraft.



Bristol Siddeley Orpheus 803



Alvis Leonides Major (helicopter)

The AD308 Teleprinter Receiver is an airborne receiver designed to operate on services of this nature. It is capable of receiving narrow-band frequency-shift-keyed telegraph services on any one of four spot frequencies in the 90-150 kc/s band and produces a double-current output suitable for operating a standard teleprinter.

Marconi's Wireless Telegraph Co. Ltd., Marconi House, Chelmsford, Essex.

Mechanism Ltd. (Stand No. 107B) This company will show the following instruments: precision aneroid barometer M.1847; Type M.1945 airspeed indicator; Type M.1861 stand-by airspeed indicator; M.1920 stand-by altimeter; M.1944 power loss indicator; Type M.1946 fatigue load meter; M.1909 accelerometer; Type M.1897 strain range recorder; Type M.1758 strain range transmitter; Types M.1918 (Mk 2A) and M.1691 (Mk 3A) machmeters; Type M.1934 machmeter; Type M.1943 machmeter; Mach switch (various types); transmitting machmeter (various types); Type M.1817 altitude switch; Mk 18 cabin altimeter; Mk 21A cabin altimeter.

Mechanism Ltd., Gyro Works, George Street, Croydon, Surrey.

Murphy Radio Ltd., Electronics Division (Stand No. 109B) Murphy Radio will show their full range of aeronautical equipment, featuring particularly the leader-cable equipment and the aircraft tape reproducer.

The leader-cable equipment, which provides the azimuth guidance for the critical phase of a B.L.E.U. automatic landing system, will be exhibited in complete form, i.e. the ground equipment and the airborne units. The ground equipment supplies power to the leader cables, which are sited approximately 250ft either side of the runway centre-line and which extend along the length of the runway and approximately 5,000ft out on the approach, so that the necessary azimuthal accuracy is available at a height of approximately 300ft to touchdown. The airborne units consist essentially of a receiver and a rotating loop assembly; these units together compare the field strength from the cables on each side of the runway, and, as the power radiated from the leader-cables is correctly balanced on each side, the airborne unit is used to determine the exact mid-course, which is a line extended through the centre line of the runway. Extensive trials of the system have indicated that the leader-cable equipment provides a guidance accuracy better than ±5ft from the runway centre. Additionally the leader cables may be used for taxi guidance. If necessary they can be arranged to provide guidance all the way to the dispersal or disembarkation point. The information derived from the airborne units is passed in a suitable form to the auto-pilot and similar information is fed from a frequency modulated altimeter to provide altitude guidance.

The MR380 aircraft tape reproducer is a conventional type of deck using twin track tape and giving a duration of 2 hr. This is achieved on a 7in reel, and the equipment, having played one track completely, reverses automatically at the end of this track and plays the second track and will repeat this 2-hr cycle indefinitely whilst the equipment is switched on.

Murphy Radio Ltd., Welwyn Garden City, Herts.

D. Napier & Son Ltd., The Vale, London, W.3 (Stand 20H) The principal exhibits on the Napier stand will be a sectioned and rotating Eland turboprop; a sectioned and rotating Gazelle free turbine; single-chamber Scorpion, Double Scorpion and Triple Scorpion aircraft and missile rocket engines; components of the Napier rocket booster system for helicopters. Also on the stand will be quarter-scale models of Napier-engined aircraft. Specimens of castings produced by the Napiercast process will be on view, and so will a "Spraymat" heated bullet. (A larger "Spraymat" exhibit will be found on the stand of Bronzavia, S.A., the French licensees for this British system of surface heating.)

Throughout the period of the exhibition, Napier and Canadair Ltd. will jointly sponsor demonstration flights by the Canadair/Convair 540 at Le Bourget, as part of a European tour organized by the two companies to draw attention to the merits of this airliner.

The Eland 504 is a single-shaft, single-spool gas-turbine with a ten-stage axial-flow compressor, six combustion chambers, and a three-stage turbine, driving a constant-speed propeller through an epicyclic

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reduction gear. The reduction gear incorporates a hydraulic torquemeter and is housed in a magnesium alloy casing that forms the air intake.

The Eland 504 has a net dry weight of 1,820 lb, a maximum diameter of 36in, and delivers 3,500 e.h.p. for take-off.

The NEl.3 version of the Eland is a standard engine to which has been added a hydraulic clutch and an auxiliary compressor. It has a take-off rating of 3,000 e.h.p., and powers the prototype of the twin-engined Fairey Rotodyne vertical take-off airliner. A more powerful version of this engine, the NEl.7, has a rating of 3,500 e.h.p.

The Eland E.229, which powers the Westland Westminster, has no propeller or reduction gear and drives the rotor shaft through a two-stage reduction gear forming part of the airframe equipment. The second Westminster will have a more powerful version, the E.229A; this has a maximum ($2\frac{1}{2}$ min) rating of 3,150 s.h.p., a one-hour rating of 2,600 s.h.p., and a maximum continuous rating of 2,400 s.h.p. The engine which will power the production Westminster is known as the E.211. This has a maximum rating of 3,500 s.h.p.

The Gazelle free-turbine engine was designed primarily for helicopters and now powers the Westland Wessex and Bristol 192. It has an eleven-stage axial-flow compressor, six combustion chambers, a two-stage turbine coupled to the compressor and a single stage free turbine which drives the helicopter rotor through a reduction gear.

The Gazelle can be mounted at any angle between the vertical and horizontal. The control system automatically compensates for loss of power in one engine of a twin-engine installation by increasing output of the other engine up to 30 per cent above its one-hour rating.

The Gazelle NGa.3 weighs 865 lb and has a diameter of 33.5in. The one-hour rating is 1,450 s.h.p. and the emergency rating 1,800 s.h.p.

All three versions of the Scorpion use high-test-peroxide as their oxidant and standard gas-turbine kerosine or gasoline as their fuel. This combination of fuel and oxidant is self-igniting and the Scorpions need neither sparking plugs nor any other form of ignitor.

Spraymat is an electrical heater-mat system that is finding extensive use in the protection of aircraft components against the dangers of ice formation in flight. It consists, basically, of a pattern of granular metal conducting elements sandwiched between two layers of insulating material, the lower layer serving also as the adhesive that holds the sandwich (or mat) to the structure. Normally, Spraymat is built up on the component but it can also be built up on a mould and transferred to the component.

The Napiercast method of casting consists of surrounding (or investing) a wax pattern of the shape to be cast with a fine grain material which will harden and remain firm, "losing" the wax by melting it, and filling the cavity with molten metal. When the metal has cooled the surrounding material is broken away and the casting released.

The Canadair-Convair 540 is the civil version of the CL-66 which Canadair is supplying to the Royal Canadian Air Force. The CL-66 is an Eland-engined version of the Convair 440, which, in turn, was developed from the Convair 340.

With Elands the Convair has 2,000 additional horse-power, a maximum permissible take-off weight 4,000 lb higher, a greater maximum payload, and a range with maximum payload nearly three times that of the piston-engined version. It can carry more fuel, takes-off in a shorter distance, can climb to 10,000ft and to 20,000ft in less than half the time required by the piston-engined version, has a cruising speed some 45-50 m.p.h. faster and, with standard seating, can carry four more passengers (48 instead of 44). With high density seating, the Eland-Convair can carry a maximum of 64 passengers. The Eland-Convair holds Supplemental Type Certificates issued by the Federal Aviation Agency of the United States, covering conversion to British standards and to American. The airworthiness trials on which the Certificates are based took place during 1958.

D. Napier & Son Ltd., The Vale, London, W.3.

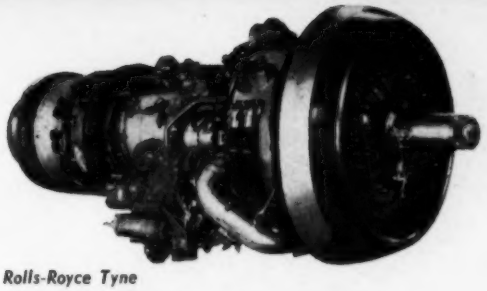
Normalair Ltd. (Stand No. 129H) Normalair and the company's Canadian and Australian subsidiaries will present a combined display, the theme of which is the company's ability to provide complete systems for aircraft pressurization, air-conditioning and oxygen equipment coupled with their unique facilities for testing and developing the equipment that goes to make up the system. The company claims to be Europe's largest producer of aircraft cabin-air conditioning systems and components. On view will be the following types of system: pressure control; pneumatic flow control; pneumatic temperature control; electric temperature control; electro-pneumatic temperature control; air cycle cooling; vapour cycle cooling; oxygen; liquid oxygen.

In the latest Normalair pressure control system—the "multi-valve" system—system operation is virtually automatic. Aircrew are required to make only two selections on an airport altitude selector in the course of a normal flight. A new range of stainless steel liquid oxygen converters is now in production, the units incorporating a new "economy" circuit. The use of this circuit gives a greater endurance for a given converter capacity, through reduction of the high evaporation losses experienced with older equipment, both in flight and during standby.

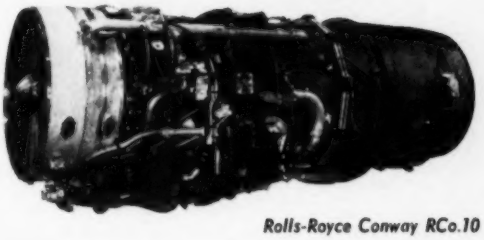
Normalair Ltd., Yeovil, Somerset.

Plessey International Ltd., Ketay Ltd., and Power Auxiliaries Ltd. (Stand No. 61bH) The trend towards the use of A.C. electrical systems has stimulated the development of many new products by The Plessey Co. Ltd., and a selection will be exhibited by Plessey International Ltd., together with synchro and servo components from an associated company, Ketay Ltd. Power Auxiliaries Ltd., also one of the Plessey Group of Companies, will display seamless flexible metallic hose.

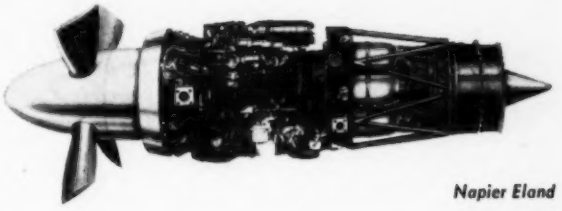
Plessey A.C. electrical units will include the Kestrel rotary actuator and the Condor twin-motor linear actuator. The Kestrel works in a 190-210V A.C. 3-phase supply. A potentiometer is included for use as a position indicator or for synchronizing two similar actuators. The Condor uses 110-120V A.C. 3-phase supplies with an auxiliary motor, in case of failure of the main supplies. A Cub Jaguar D.C. linear actuator will also be on view.



Rolls-Royce Tyne



Rolls-Royce Conway RCo.10



Napier Eland

Products typical of those being increasingly used in aircraft engineering will be displayed by the Plessey Aircraft Mechanical Division. They include a ram-air turbine for emergency electrical supply. Ejected into the airstream, in the event of engine failure, the turbine driven alternator will provide up to 15kW, thus ensuring that control of the aircraft can be maintained during descent. Constant frequency from the alternator is obtained by governor-actuated inlet guide-vanes controlling turbine speed. A high-temperature screw-jack will be exhibited. The actual unit has successfully completed 70 hr running time at a constant temperature of 400 deg C cycling under loads from 350 lb to 850 lb with dry lubricant. Also shown will be a missile hydraulic pump, a high-speed unit developed to operate over a very wide temperature range. Other products will include air motor driven ram Type 100/6, suitable for use in single or multi-actuator systems; IPN monofuel guided weapon power pack, specially developed for re-charging servo hydraulic accumulators; engine-driven backing pump, with a nominal rating of 13,600 litres/hr at 2,500 r.p.m. for pumping of aircraft fuels in an unfiltered state; A.C. motor-driven fuel-booster pump; a lightweight hydraulic starter motor for gas turbines; and governor pump Type GPO78, which supplies fluid to servo systems at outputs proportional to pump speed.

Products shown by the Plessey Wiring & Connectors Division will include some of the company's range of UK-AN electrical connectors.

Radio communication equipment shown by the Plessey Electronics and Equipment Group will include a UHF multi-channel high-power 100W transmitter on which 12 channels (selected from 1,750 channels) can be preset at a time, any of which can be selected locally or remotely, and a multi-channel UHF receiver, which is a double super-heterodyne with a two-stage R.F. amplifier using a "butterfly" tuning system. Also displayed will be an AN ARC/52 airborne transmitter-receiver.

Exhibits will also include numerous components from the Plessey Components Group for use in the aircraft and electronic industries.

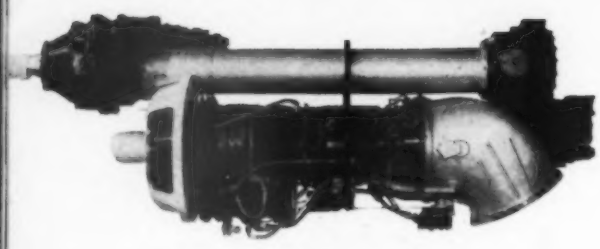
Plessey International Ltd., Vicarage Lane, Ilford, Essex. Ketay Ltd., Eastern Avenue West, Romford, Essex. Power Auxiliaries Ltd., Kembrey Street, Swindon, Wilts.

Rellumit (London) Ltd. (Stand No. 14A) Equipment to be exhibited by the French parent company will be as follows: range of filters suitable for aviation fuels, diesel fuel, nitric acid, air, etc.; water separator equipment with dumping gear systems; nitric acid and fluorine refuelling unit; motorized overwing hydrant dispenser; underwing pressure coupling; nitric acid coupling; nozzle; and floating suction loading arm.

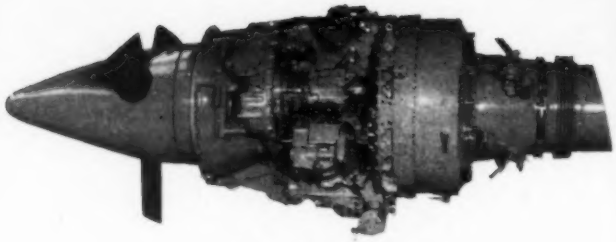
Rellumit (London) Ltd., Chandos House, Palmer Street, London, S.W.1.

Rolls-Royce Ltd. (Stand No. 16H) The following engines will be on display: Conway RCo.10, Avon RA.29, Avon RA.24 with reheat, Tyne, and RB.108 jet-lift engine. In addition Rolls-Royce will have a special display of some components of Dart turboprops which have achieved high life in airline service. The theme will be how long-life parts contribute to economical operation.

Of the engines exhibited, the Conway and the Tyne now have very important civil applications. The Conway is a by-pass engine. Briefly, the by-pass principle consists of a two-spool turbojet in which the low-



de Havilland Gnome



Bristol Siddeley P.182

Britain's Contribution to the Paris Show . . .

pressure compressor is of increased diameter and discharges air partly through the second (high-pressure) spool, combustion system and turbine, and partly through a by-pass duct surrounding the remainder of the engine. The two flows are then mixed in an optimum manner in a single jet-pipe which can be fitted with thrust reversal and a noise-suppressing nozzle.

In the design of the Tyne turboprop, Rolls-Royce determined to achieve the highest possible efficiency, and accordingly chose a high flame-temperature (made possible by the employment of air-cooled turbine blading) and a pressure ratio of 13 : 1 achieved by compression split between two spools. The propeller for the Tyne is a very advanced unit designed by de Havilland Propellers Ltd. Considerable development has gone into the largely automatic system which controls the fuel flow and the propeller, and handling is now of an extremely high order. First airline service is scheduled with B.E.A. for March 1960. These initial V.951 Vanguards will be fitted with the RTy.1 Mk 506 rated at 4,500 s.h.p. (4,985 e.h.p.). Succeeding Vanguards will have the second production engine, at the RTy.11 rating of 5,030 s.h.p. (5,525 e.h.p.). These Tynes incorporate several design improvements, including rematching to an even higher turbine entry temperature made possible by improved blade materials, and achieve a cruising s.f.c. of 0.388 lb/hr/e.h.p. For the Canadair CL-44 the RTy.12 has a larger final nozzle in order to provide increased shaft-power at take-off, the propeller size being correspondingly increased. The RTy.12 has a military dry rating of 5,300 s.h.p. (5,730 e.h.p.) and is likely to enter service with the R.C.A.F. in the summer of next year. An essentially similar engine will be fitted to the Short SC.5 Britannic 3 for the R.A.F.

Rolls-Royce Ltd., Nightingale Road, Derby.

Rotax Ltd. (Stand No. 99A) In addition to complete electrical systems for aircraft, complete starting systems for aircraft engines and the established products manufactured by Rotax, emphasis will be placed on new equipment. Some details follow.

Brushless alternator, in ratings adequate to supply the main loads in aircraft, the most satisfactory brushless alternator at present is claimed to be the type having a main rotor fitted with integral rectifiers. These revolve at rotor speed and deliver D.C. exciting current by rectifying the output from the rotor of a smaller a.c. exciter running on the common shaft. Electrical interconnection between the rotors via the rectifiers is readily effected because the connections and rectifiers are mounted inside the shaft. One of the outstanding advantages claimed for this alternator is that brushwear problems at altitude have been eliminated.

Ram-air turbo-alternator. Designed for emergency electrical power if the aircraft power plants have failed, this alternator has an output of 15 kVA with a frequency of 400 c/s, and voltage 208V. The alternator is driven by a variable-pitch turbine; a constant speed, to within ±5 per cent, is obtained by a governor and pitch-change mechanism.

15 kVA Bleed-air turbo-alternator. This is a high speed (24,000 r.p.m.) machine. It is a two-pole blast-cooled alternator with its rotor and turbine wheel mounted on a common shaft running at the governed speed of 24,000 r.p.m. It is suitable for parallel operation with similar alternators by the addition of a small power-equalizing unit and a protection unit fitted with a synchronizing device. Control gear is arranged for automatic starting under all air inlet conditions.

Transistorized inverter. This unit is claimed to have the following advantages: It is a self-contained unit, no external starting or panel being required. Power is obtained immediately the inverter is switched on, and there is no surge current.

Pneumatic (low-pressure) starter. A range of these units has been developed, one of the latest being for use on gas turbine engines having moments of inertia up to 500 lb-ft. This unit has been designed for use in low pressure, high temperature pneumatic starter systems.

Bristol Bloodhound on launcher

Flashing warning lamp. The "attention-drawing" properties of this unit distinguish it from the usual type of warning lamp; two bulbs housed in the cover are clearly visible through an angle of 180 deg.

Navigation-lamp flasher. This is a transistorized version of the Rotax flasher unit; advantages over the latter are that no suppression is required and it is completely free from radio interference.

Rotax Ltd., Willesden Junction, London, N.W.10.

Scottish Aviation Ltd. (Stand No. 65H) This company will be represented by a Twin Pioneer general-purpose military aircraft on loan from the R.A.F. Powered with two Alvis Leonides engines, this type is suitable for passenger or troop transport, paratroop work, casualty evacuation, supply dropping, freight transport or photography. As an air ambulance the Twin Pioneer takes up to 12 casualties (including nine stretcher cases). In the paratrooping rôle the metal door is replaced by light canvas zipped into position. The stores accommodated under the stub wings can include four light-equipment containers or two 1,000 lb bombs, or four 500 lb bombs, or four 250 lb bombs.

Scottish Aviation had intended to show a re-engined Series 3 Twin Pioneer powered with the new Alvis Leonides 531/8 engines—an installation which gives improved all-round performance. Unfortunately only one aircraft is available with this new engine, and this is engaged on a flight-test programme prior to a tour of Africa beginning later in June. The Scottish Aviation stand will be a small one whereon will be displayed a model of a 16-passenger Twin Pioneer.

Scottish Aviation Ltd., Prestwick Airport, Ayrshire.

Short Bros. & Harland Ltd. (Stand No. 79H) Shorts will show a model of the Britannic long-range freighter recently ordered by R.A.F. Transport Command and another of the SX-A5—a test vehicle used in preliminary research on the Short Seacat ship-to-air missile, designed to replace the 40 mm guns of the Royal Navy. A development contract for Seacat has been placed by the Ministry of Supply. The new weapon will deal with a high degree of effectiveness with aircraft should they evade the outer defensive fighters and long-range guided weapons. It will also provide an anti-aircraft armament for small ships. Seacat is a small and highly manœuvrable weapon. It is powered by a solid fuel motor and is designed to be instantly ready to attack. Progress on Seacat has been discussed with Senior Navy and Army officers of Commonwealth, NATO and other countries. Several of these countries are keenly interested in the project and the weapon created a considerable impression at the recent presentation of British guided weapons in Paris.

Another model will depict the SC.1—Britain's first all-jet-powered VTOL aircraft project. It has been designed and built by Shorts under contract from the Ministry of Supply. The company is handling all design and development work on the aircraft, including the auto-stabilizers and control systems. These are the responsibility of the company's Precision Engineering Division, working in conjunction with the Royal Aircraft Establishment.

Also in model form hypothetical strike aircraft of the future will be seen operating from small platforms in forward areas. There are no runways; the platforms are sectioned and carried to and from the site by road transport.

There will also be a diagrammatic outline of the control system of the target version of the Canberra developed by Shorts for pilotless operation in guided weapon firing trials. The exhibit will illustrate not only the control system but also a typical flight plan.

Short Bros. & Harland Ltd., Belfast, Northern Ireland.

Smiths Aviation Division (Stand No. 55B) In collaboration with the Sperry Gyroscope Co., Smiths Aviation Division will be represented by a wide selection of products. On view will be a mock-up of the flight panel of a four-jet transport, fully instrumented by Smiths. Individual exhibits include the S.E.P.2 gyro unit, flight data system and a selection of fuel gauging equipment and small motors.

The flight data system integrates flight, dynamic and aerodynamic information in a minimum of panel space. The servo-operated display units respond to data received from separate sensing, detector and computer units and present unambigious information to the pilot. This new approach to the problem of instrument presentation has been developed for high-speed fighters, but is equally adaptable for civil applications. It has been designed in collaboration with the Ministry of Supply and the Institute of Aviation Medicine.

The EC 27 jet-pipe temperature control amplifier consists of two basic sub-units, a reference voltage with which the thermocouple is compared, and an amplifier giving an output of five watts into a 30 ohm fuel control solenoid when the thermocouple voltage exceeds the set reference voltage. Temperature is sensed by KLG thermocouples, connected by compensating leads to the amplifier. Thermocouple cold junction compensating and stabilization against voltage changes are provided in the reference voltage unit.

The jet transport aircraft panel will be completely equipped with flight navigational and engine instruments. Of particular interest is the

flight instrument display showing the application of the new I.F.A.L.P.A. cockpit recommendations for the basic T and a group of six central instruments. In this group are the display instruments of the Smiths flight system. Other noteworthy features are the servo altimeter, the new presentation mechanical altimeter, miniature position indicators and the engine instrument display.

Smiths Aviation Division, Livingstone College, Leyton, E.10.

Sperry Gyroscope Co. Ltd. (Stand No. 55B) Sperry exhibits will be located in two separate displays, one on Stand No. 55B in the main exhibition hall and the other in a special Seaslug display adjacent to the missile park in the outside concourse.

On Stand No. 55B Sperry aeronautical exhibits will include selected examples of advanced equipment under development, notably the visual flight director, twin-gyro stable platform, helicopter stabilization equipment, "Rotorace" Gyrosyn compasses, selected gyro horizons (including the AC/DC type H.L.9), miniature servo components and a design of automatic pilot for high-performance aircraft to provide automatic control on one or more of the three axes.

Sperry aeronautical exhibits will be shown adjacent to those staged by Smiths Aviation Division, and these two sections of the stand will be linked by a feature of the Airco D.H.121, for which Smiths and Sperry are collaborating in the design of flight instrumentation and control equipment. The Smiths and Sperry displays will otherwise be separate. The Seaslug exhibit is being staged by the three principal contractors on this ship-to-air weapon, namely Sir W. G. Armstrong Whitworth Ltd., The General Electric Company Ltd. and Sperry Gyroscope Ltd.

The Sperry visual flight director display uses a representation of the forward part of a cockpit, including especially the windscreen on to which is projected optically the cross-pointer display of the Zero Reader flight director. A photographic background behind the windscreen portrays alternatively an approach phase or low flying and enables the features of this new development of the flight director technique to be appreciated readily. The twin-gyro platform exhibit includes the sealed platform unit, in which two "Rotorace" directional gyros are orientated at right-angles and so gimballed that they provide a heading reference of inertial quality (free drift rate less than 0.5° per hour) and also at the same time a precise vertical reference.

The "Rotorace" directional gyro will be that used in the Sperry C.11 Gyrosyn compass to provide the most accurate compass reference available for polar navigation or use with advanced navigational systems, such as Doppler. A pictorial display based on the Fiat G.91 serves to introduce Sperry electro-hydraulic autopilots for high-performance aircraft where there is a requirement for automatic control on one or more axes. A pilot's controller of the A.L.30 gyropilot will represent the automatic pilot series being installed in the Friendship, Noratlas, Herald, Pembroke and other aircraft.

Sperry Gyroscope Co. Ltd., Great West Road, Brentford, Middlesex.

Teleflex Products Ltd. (Stand No. 39A) Examples of Teleflex cable-tension regulators, used in the flying- and engine-control systems of practically every new British aircraft, will be exhibited, and there will also be examples of the Teleflex remote-control system with fluon-lined conduits. The regulators on show will include examples for the Viscount, Vanguard, Argosy, Herald, Friendship, NA.39, Sea Vixen and Swiss Venom. Particularly interesting will be regulators for the NA.39's aileron and tailplane system.

Teleflex Products Ltd., Basildon, Essex.

Vickers-Armstrongs (Aircraft) Ltd. There will be no Vickers-Armstrongs (Aircraft) stand, but the company hope the first B.E.A. Vanguard will fly over on the Press day (June 11) and will be in Paris from June 19-21 inclusive.

The Vanguard is a large turboprop airliner (four Rolls-Royce Tynes) which sprang from a B.E.A. requirement for an aircraft which, while offering competitive speed (up to 425 m.p.h.) and comfort, would improve to a revolutionary extent the inherent difficulty of making a profit out of short/medium-haul route networks—especially those subject to heavy "peak" problems. Vickers claim that, at a 65 per cent load factor, the 139-seat Vanguard can operate at a 10 per cent clear net profit with fares ranging from 30 to 50 per cent below current tourist rates. Percentage fare-reductions actually calculated for particular routes vary from 29 per cent on a 239-mile stage to 50 per cent on a 686-mile stage. The Vanguard has a span of 118ft.

In the guided weapons park will be a simulator room in which the operation of the Vickers Vigilant anti-tank weapon can be studied and in which a visitor can actually "fire" a mock missile. This room is used for instruction and for training potential Vigilant operators. Component parts of the Vigilant—a detailed description of which appeared in *Flight* of May 22—will be shown outside.

Vickers-Armstrongs (Aircraft) Ltd., Weybridge, Surrey.

W. Vinten Ltd. (Stand No. 107B) Included in the Vinten production programme are the following airborne cameras: 70 mm reconnaissance camera (F.95); 16 mm combat recording camera (G.90); 35 mm geological survey camera.

Among the research camera equipment they are able to offer are the take-off camera (F.47) and the 35 mm high-speed camera (H.S. 300), both of which are in use by the Ministry of Supply and private companies engaged in aircraft and allied industries.

W. Vinten Ltd., North Circular Road, London, N.W.2.

Westland Aircraft Ltd. (Stand No. 30A) Four Westland helicopters will be at Le Bourget. The Widgeon will be there throughout the whole show, from the 11th to the 21st or 22nd. The development Whirlwind with the de Havilland Gnome turbine will be present, together with the Wessex and the Westminster, to give flying demonstrations on the 18th and individual demonstrations on the 19th. These three aircraft will arrive on the 17th and return either on the evening of the 19th or the morning of the 20th.

On the stand there will be a scale model of the Westminster crane prototype and smaller models of the other members of the Westland family. Particular interest will, of course, be aroused by the three turbine-engined helicopters—the Westminster, Gnome-Whirlwind and Wessex. The Westminster has recently been undergoing weight-lifting trials in its "crane transporter" rôle. It is the largest twin-turbine, mechanically driven, single-rotor helicopter in the Western world and is claimed to be able to operate with full payload on one of its Napier Elands if need be. With its disposable load of some 14,000 lb the aircraft meets the requirement for a large military transport able to carry heavy field equipment, tactical and nuclear weapons and troops over stages of 150 miles or more. Typical loads could be 51 troops, five missiles or four jeeps. The two Napier Elands are mounted side by side ahead of the main gearbox on top of the fuselage. A civil version is projected. The Wessex has been adopted by the Royal Navy as its standard anti-submarine aircraft. Powered with a Napier Gazelle free turbine, it has a maximum speed of 144 m.p.h.

Westland Aircraft Ltd., Yeovil, Somerset.

Above, de Havilland Propellers Firestreak (on Sea Vixen). Below, English Electric Thunderbird (on launcher). Right, Vickers Vigilant and the Armstrong Whitworth Seaslug (on launcher)

Henry Wiggin & Co. Ltd. (Stand No. 37H) The Wiggin display will feature the widespread uses of Nimonic and Nimocast alloys in gas turbines and other power units. These alloys, besides being standardized for the rotor blading of British gas turbines, are employed for flame tubes, discharge nozzles, turbine discs, structural rings, exhaust units, afterburners, thrust reversers, noise suppressors, tip jets, catalyst plates, etc.

A secondary display will show how other Wiggin nickel alloys such as Monel, Inconel and the Brightray series are used in aircraft components.

Henry Wiggin & Co. Ltd., Birmingham, 16.

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

Flight-deck Staffing

I HAVE read Mr. Becu's letter on the above subject published in *Flight* for May 29 and am concerned about the references to B.A.L.P.A. in the final paragraph of that letter.

I can well understand Mr. Becu's desire to protect the interests of those members of the flying staff who constitute the bulk of the civil aviation section of the membership of the International Transport Workers' Federation, but I take exception to the reflections cast on the integrity of the pilot groups contained in that letter. I have no doubt, however, that I.F.A.L.P.A. will deal with that aspect of Mr. Becu's letter.

In his references to B.A.L.P.A., Mr. Becu stated that B.A.L.P.A. had been "publicly rebuked" for negotiating agreements involving the take-over of navigating, flight engineering and radio duties without any attempt at consulting the other unions concerned. The "public rebuke," so called, was contained in a resolution of the trade union side of the National Joint Council passed in December 1956. In that resolution B.A.L.P.A. was jointly arraigned with B.O.A.C. and the Employers' Secretariat of the National Joint Council. B.A.L.P.A., B.O.A.C. and the Employers' Secretariat separately rejected the terms of that resolution.

In so far as B.A.L.P.A. is concerned, the Association has at all times offered to discuss matters of crew complement with unions representing flying-staff officers other than pilots. It is an unfortunate fact, however, that agreement has rarely been reached; indeed, on occasions before December 1956 the Association's offers to discuss these problems were not accepted.

London, W.1. D. FOLLOWS,
General Secretary,
British Air Line Pilots Association.

VERY little, in my view, is to be gained by one international organization attacking another by means of public correspondence and I very much regret that Mr. Becu, by his letter in your issue of May 29, has taken this course. I can, however, hardly let the issue pass without some correction to the impressions of I.F.A.L.P.A. policy on crew complement which the letter may have left.

First of all, Mr. Becu raises the question of the representative character of the two organisations and claims that the I.T.F. represents 40,000 flying staff. It is well known, however, that many of these are stewards and stewardesses (who are not, of course, directly concerned in the operational crew-complement issue), and I doubt very much whether there are 1,000 pilots or 5,000 operational personnel all told. This is a long way from the 40,000 claimed by Mr. Becu or from the 21,882 active airline pilots of this organization.

Mr. Becu goes on to say that specialist flight-crew members have been "recklessly dispensed with on the alleged grounds that technological development has made them unnecessary". This, of course, is as much an attack on company safety policies as it is on I.F.A.L.P.A. The facts are that dispensing with the specialist crew-member has been by no means a reckless affair, and there have been many cases (e.g., the radio operators of Qantas, B.O.A.C., K.L.M., Sabena, T.W.A., South African Airways) where the specialist was retained on particular sectors mainly at the insistence of the pilot group who, in their evaluation of the facilities and the workload, did not consider the developments at that time adequate to dispense with him. It is, therefore, quite wrong to say that there has been pressure by the pilot group to deprive the specialist of his job.

On the other hand, we have not felt it right to support the carriage of unnecessary crew members purely for the sake of maintaining "good" trade union principles. We do not think that the principle of resistance to technological advance is applicable to the twentieth century—particularly to the aviation industry—and that the answer to it must always be in adaptation and more adaptation. The whole trend of the industry and the design of the aeroplanes dictate these changes, and this is, indeed, recognized by the majority of companies. For example, T.C.A., Qantas, B.O.A.C., B.E.A., Aer Lingus, S.A.S., U.A.L., A.A., Braniff, Delta, P.A.A. and almost all operators who are buying large turbine-powered aircraft have come to the conclusion that the basic navigational crew should be three pilots. In some cases an additional crew-member will also be carried.

I.F.A.L.P.A. has no objection to this; indeed, particular aircraft designs, particular routes or lengthy flight stages may well demand an additional crew-member—either a specialist or a pilot. How can it then be said that our members "have threatened the jobs of other crew members"? All we have said is that large turbine-powered aircraft demand a basic operational crew of three pilots. Nothing in Mr. Becu's letter would appear to controvert this contention, and I would be surprised to hear a sound argument against it from him or from anyone else. On the contrary, many operators of large jets have publicly announced their agreement. For example, when A.A. announced their decision in favour of the third pilot, they made it clear that the action was taken "solely in the interest of the highest degree of safety". Would the company have taken this action to featherbed the pilot or to provide against pilot redundancy, as implied by Mr. Becu?

I trust that the above will put the crew-complement position in somewhat better balance, but I should not like it to be thought that this organization is unsympathetic to the I.T.F. in the present transitional stage through which the industry is passing. We do, indeed, feel that aviation owes much to the specialist flight crew-member and should, as far as is humanly possible, find a way of retaining and turning to advantage his experience and enthusiasm. In many cases (e.g., T.C.A., S.A.S., B.O.A.C.) suitable retraining arrangements have in fact been made for some categories and we trust that all airlines will follow and extend this practice.

London, W.1. C. C. JACKSON,
Executive Secretary, International
Federation of Air Line Pilots Associations.

The Prestwick Viscount Crash

IN his letter concerning the Prestwick Viscount crash report [May 22] Mr. W. H. Hankin must really be running short of excuses when he tries to exonerate himself at the expense of the Air Traffic Control Service, and what a pity it is that he risked tarnishing his reputation by the omission to check just a few elementary facts; therefore the Guild of Air Traffic Control Officers would ask the courtesy of your columns to permit them to counter Mr. Hankin's erroneous criticism of the controllers concerned.

It will be seen from the report that Viscount G-AORC reported over New Galloway at 2157 and subsequently over Prestwick non-directional beacon at 2205, thereby covering a distance of some 24 n.m. in 8 min, giving a ground speed of 184 kt. His initial call to Prestwick Approach (note, not Prestwick Director) was at a little after 2158 or 19½ n.m. from Prestwick N.D.B. At this point, no doubt, the aircraft was under procedural control and the mis-report by Mr. Hankin of 11,000ft would have concerned only those altitudes between say, 10,000 and 14,500ft. As the aircraft was in continuous descent, standard airways separation would have precluded any traffic being in the vicinity of MPN1 radar coverage. The first contact with the G.C.A. director was at 2303½—one-and-a-half minutes, or approximately six miles, from the N.D.B. If Mr. Hankin had checked a little further on his facts, he would no doubt have discovered that not only would this be in the cone of no signal of the radar in question, but would also have been in the area of non-discrimination due to permanent ground echoes.

He must be aware that the whole system of procedural airways control is based upon the interpretation of pilots' reports, supported in some cases (not this one) by *en route* radar plotting and the acceptance of the philosophy that airways flights are carefully pre-planned and accomplished in a competent and orderly manner. Surely he does not seriously suggest that the system should be so conditioned that each report should be treated with suspicion and endeavours made to relate it to every random aircraft return on radar with known traffic just in case. In this instance, without the use of CR/DF and height-finding the air traffic ontrol officer would have no way of checking the accuracy of the pilot's report; and even if he did see a momentary aircraft response on his tube just before the permanent-echo clutter it is unlikely that he would have consciously connected this with the Viscount.

In answer to Mr. Hankin's question we are convinced that he had the fullest co-operation which he could justifiably ask from both the Centre and the Aerodrome Control units and that his aspersions against them are most unfair and unreasonable. His belief that one controller could at the last minute rectify the complicated sequence of errors which occurred in the cockpit that night is surely a flight of fancy.

London, W.1. K. I. PEARSON,
Master, Guild of Air Traffic Control Officers.

Air Political Restrictions

IN *Flight* for May 8. page 646, I read the comments of Roger Bacon on a speech which I delivered during the Congress of the International Chamber of Commerce in Washington on April 22.

I am quoted as having referred to "the long-standing refusal of the U.K. to allow American airliners to land in Hong Kong". In fact, I did not use the plural sense, but referred only to *a U.S. carrier* [Northwest Airlines]. This reference served to illustrate the deplorable chain-reaction caused by air political restrictions.

The Hague. (DR.) H. A. WASSENBERGH,
Deputy Head, Foreign Relations
Department, K.L.M. Royal Dutch Airlines.

ZENDAYA